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10 AIRPLANES FACING EXTINCTION

**Today's Airliner,
Tomorrow's
Skateboard?**

(P. 58)

**An Airplane
We Bet You
Never Heard Of**

(P. 38)

Northrop N-9MB
Flying Wing

**How to Build a
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MARCH 2007

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Our scientifically impeccable DiamondAura Canary Ring displays the many hues of a radiant sunrise for only a fraction of the cost.

As a member of the community of jewelers, I have the opportunity to frequently visit Antwerp, Belgium, the Diamond Capitol of the World. All of the most renowned jewelers buy their best diamonds here. My 5th generation Belgium gem broker is at the top of his trade and enjoys finding a special gem with a certain size, shape, color and clarity—he doesn't trade in what is available on the local market. Recently he was excited to discover a hoard of the most sought after diamonds today: Canary and Fancy Yellow diamonds. Many people find yellow diamonds more desirable than any other color due to their inherently warm optic color.

During our visit, he proudly displayed a brilliant round-cut Canary diamond, explaining that natural yellow color diamonds are 10,000 times more rare than their brilliant white, colorless counterparts. Turning the stone in the light, he said the intensity of color is of paramount importance, and clarity increases the inherent value of a high-quality color diamond. He said this fine

Canary Yellow gemstone, framed by two white diamonds, should retail for at least \$10,000. As my broker admired this treasure, I decided now was the time for a little amusement.



Our Natural Mined Canary Ring

Fancy Yellow Round-Cut Diamond (.67 carats):

Natural yellow color
Clarity rating: VS

Two Companion White Round-Cut Diamonds (.49 total carats):

Color rating: G-H
Clarity rating: Si1

Setting: Platinum and 18K gold

As he glanced away, I placed a similarly colored lab-created DiamondAura yellow stone next to the natural mined diamond. My broker thought he was seeing double. I asked him to choose the mined diamond, but he said he could only guess. After close examination he was astonished—the faultless, lab-created stone

was so visually similar in almost every way! He started to wonder about the future of the diamond business.

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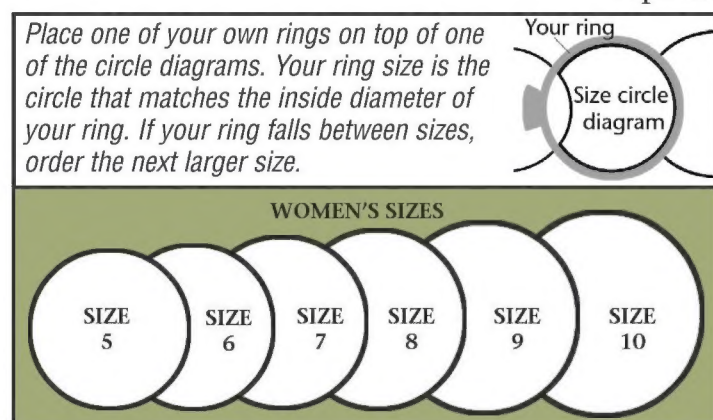
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WRITTEN QUIETLY. SOMETIMES IT REQUIRES
A SONIC BOOM.

No person has pushed the limits of man and technology like Chuck Yeager. The year was 1947. Nobody knew if a fixed-wing airplane could break the speed of sound. More curiously, whether a human could survive the tremendous force of that kind of speed. Yeager was already a legend among WWII fighter pilots when he took off in the X-1 that day. Not only did he reach Mach 1 and create the first man-made sonic boom, he did it again fifty years later in an F-15 fighter. His résumé of military and civilian accomplishments is comprehensive enough to consume chapters in aviation history books. If one person defines what it is to be a man among men, he is Chuck Yeager.



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ON THE COVER Three cheers for ones-of-a-kind: Jack Northrop, who in 1942 created an aircraft that looks futuristic today; the Planes of Fame Museum, which keeps the N-9MB Flying Wing flying; and Philip Makanna, who made the spectacular photo and proposed this issue's story on sole survivors (p. 40).

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NEW

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JOIN THE AIR & SPACE READER SCRAPBOOK! Inspired by letters and photographs we've received over the years, we're planning to exhibit a selection of digital images from our readers' personal collections. To find out how to participate, see p. 78.



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Printed in the USA

Treasures of American History

THE SMITHSONIAN INSTITUTION has often been called "the nation's attic." With more than 136 million objects in the collections, the process of identifying, acquiring, preserving, and presenting all of these is far more selective and complex than that term implies. Sharing the collections with the visiting public can be difficult for many reasons, including lack of space. When the decision was made to temporarily close the popular National Museum of American History for renovation, we at the National Air and Space Museum were delighted to make a gallery available so that some of the most famous icons of American history could remain on view during this transitional period.

The 5,000-square-foot gallery, "Treasures of American History—at the National Air and Space Museum," is organized into four themes: Creativity and Innovation, American Biography, National Challenges, and American Identity. The exhibition, which opened last November, showcases a phenomenal array of objects, many of which were previously in storage. Abraham Lincoln's top hat, Margaret Mead's fieldwork dress, George Armstrong Custer's coat, Susan B. Anthony's shawl, and Ray Charles' tuxedo are among the articles of clothing on display. Different periods in the struggle for freedom and racial equality are represented by the lunch counter from Greensboro, North Carolina, where four African-American students began a sit-in that lasted for six months; a pike from John Brown's Raid in 1859; and an

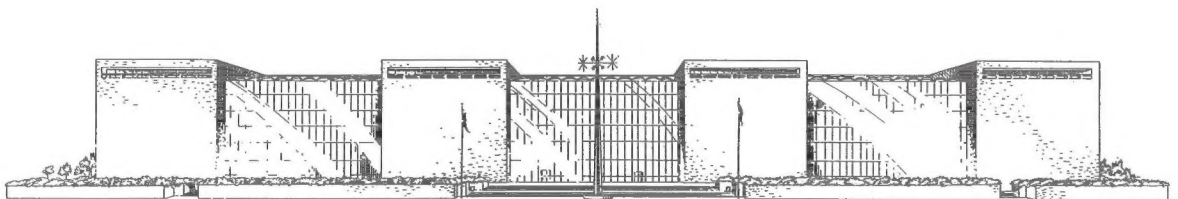
1833 slave tag. Thomas Edison's light bulb is on view, as are an 1876 telephone used by Alexander Graham Bell to demonstrate his new invention and vials of polio vaccine and a syringe used by Jonas Salk.

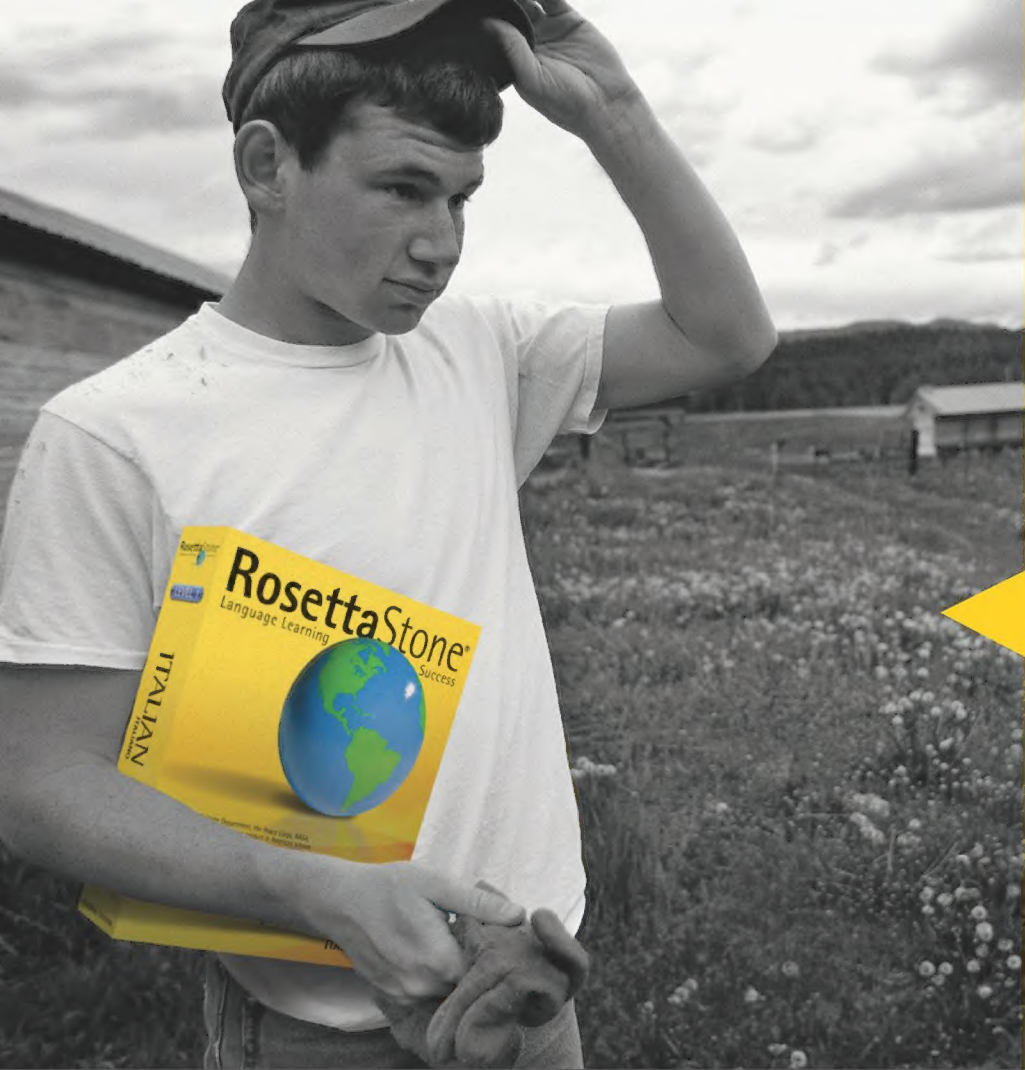
From the world of entertainment, Kermit the Frog, R2-D2, and C-3PO will greet visitors, who will also be able to view the signpost from the television series "M*A*S*H," the puffy shirt from "Seinfeld," and Mr. Rogers' red sweater. With a personal appearance last December, Sylvester Stallone added the robe he wore in the film *Rocky* and memorabilia from its sequels.

In this gallery, representations of recent momentous events join articles from the past. The inaugural display included objects from New Orleans and the Gulf Coast collected after Hurricane Katrina. Every few months artifacts will be added as the National Museum of American History continues its collecting efforts.

The National Air and Space Museum is honored to have been chosen to host this exhibition of objects from the National Museum of American History. Combined with artifacts from the National Air and Space Museum, these displays provide the visitor with a uniquely meaningful experience. From the compass Lewis and Clark used to explore our young country to the boots that left footprints on the moon, the artifacts represent the progress of American history, as well as the pioneering spirit that is our national legacy.

■ ■ ■ J.R. DAILEY IS THE DIRECTOR OF THE NATIONAL AIR AND SPACE MUSEUM.





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Surprise Appearances

In "Mystery on Guadalcanal" (Dec. 2006/Jan. 2007) Ralph Wetterhahn quotes a native, Bruno Nana, referring to "a German working with the Japanese." Whoa! This is the first time I have ever read of a German on Guadalcanal during World War II. Who was this guy, what was he doing there, and did he survive? I have heard of the occasional U-boat voyage to Japan, but aside from that, is there any evidence of Germans being involved in the Pacific war?

Brian Fallon
Pittsford, New York

Ralph Wetterhahn replies: In the 19th century many islands in the Solomon chain were under German jurisdiction. Early in the 20th century most were transferred to British administration, except for Buka and Bougainville, which remained under German administration until occupied by Australia at the start of World War I. Thus, small colonies of German expatriates remained scattered across the island chain. When the Japanese invaded in World War II, they employed some Germans, as civilians, to communicate with the locals. I have not been able to determine if the one Bruno Nana encountered survived.

The caption on page 37 identifies the remains of a U.S. pistol, caliber .45, model 1911A1, as a revolver. The propeller on the same page is carefully described as coming from a Pratt & Whitney R-1830, which is a radial engine, not an inline one. Likewise, you can describe the 1911A1 as an inline pistol, not a radial revolver.

Charles D. Porter
Chino Hills, California

Be Careful What You Wish For

As part of the ground forces in Europe in World War II—I was in the 45th Infantry Division—we didn't know that the Germans had such a fearsome weapon ("Stormbird," Oct./Nov. 2006). We experienced Me 109s at treetop



In "Build This Airplane for 10 Grand" (Dec. 2006/Jan. 2007), the above photograph should have been credited to G.R. Dennis Price. We regret the error.

level and saw a few high-flying Heinkels, but never an Me 262. As we slogged along on the ground, we all wished we could be flying high overhead with the Air Forces, but now, when I read about this first jet fighter and its performance, I think we were better off on the ground, up against conventional German forces and weapons we understood.

Bill Battis
Sun City West, Arizona

Spiral In, Spiral Out

"Landing in Baghdad" (Oct./Nov. 2006), which describes the harrowing approach technique required to land at the Baghdad International Airport, raises a question. Is any special procedure used for departures?

Martin A. Snyder
Dublin, California

Allan T. Duffin replies: Departures from the airport use the same type of spiral procedure, but done in an upward fashion. The goal is the same: providing insurgents with less of a target.

I didn't invent defensive descents, but I did write a book about them. In *Flying Tigers over Cambodia* (McFarland & Co., 2000) I recount a period in which, for 25 straight days, a group of volunteer U.S. pilots made one to four such descents a day into Pochentong airport in Phnom Penh, Cambodia. This was during the Khmer Rouge siege of the area in 1975.

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The Time Machine. We took the timepiece to George Thomas, a noted historian and watch restorer for museums



The open exhibition back allows you to further explore the intricate movement and fine craftsmanship.

such as the Smithsonian, and he dissected the 110 parts of the vintage movement. He gave the "1779" top reviews. "It is possible to build it better than the original, and your new skeleton requires so little maintenance." When we shared the price with him, George was stunned. He said that no other luxury skeleton can be had for under \$1000. But we pour our money into the watch construction, not into sponsoring yacht races and polo matches. We have been able to keep the price on this collector's limited edition to only three payments of \$33.00. So

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At Pochentong, small arms weren't the main threat, but the Rouge had SA-7 heat-seeking missiles, which could have ruined our day. We would approach the airport at 12,000 feet, and when overhead would deploy full landing flaps and gear. Then we would start the steep spiral down to 800 feet above ground level, and land ASAP.

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Larry Partridge
La Conner, Washington

William Faulkner, Aviation Novelist

Your article on Shushan Airport ("No More New Orleans Cover-up," Then & Now, Dec. 2006/Jan. 2007) made me recall a less successful example of 1930s Modernism: the fictional one William Faulkner rendered after he attended Shushan's 1934 opening. The real airport was named after the president of the Levee Board of New Orleans; in his novel *Pylon*, Faulkner renames the airport Feinman, after the chairman of the Sewage Board of "New Valois." Most of the action centers on air races that inaugurate Feinman Airport.

In 1958 *Pylon* was made into a movie, *The Tarnished Angels*, directed by Douglas Sirk and starring Rock Hudson and Robert Stack. Some critics think it has the best flying footage of the time.

Michael Thro
Norfolk, Virginia

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More Cold War Storylines

I logged over 2,000 hours in the F-86D and did some test flying for SAGE (the Semi-Automatic Ground Environment program), so I was surprised to see that in "The Thin Aluminum Line" (Dec. 2006/Jan. 2007) Carl Posey failed to give recognition to the role of the F-86D. One cannot discuss the history of the Air Defense Command without recognizing that the F-86D was the command's original all-weather fighter-interceptor, and remained the principal such aircraft for several years.

David E. Stein
Montgomery, Alabama

Carl Posey replies: The F-86D, which came along after the Korean conflict, was, according to some sources, born of delays in getting an F-89 that worked. So the history of the -D branches away from the history we wanted to cover, namely the brief age of purpose-built interceptor designs, beginning with the Scorpion, with a nod to SAGE and the Distant Early Warning (DEW) Line.

The F-86D story deserves to be told. It's a corker.

Always good to read about under-appreciated facets of U.S. Air Force cold war history. The Peterson Air and Space Museum (www.petemuseum.org) includes in its collection 18 aircraft and missiles relating to the U.S. air defense mission. Many of our volunteers are former air defenders—aircrew, radar operators, and maintainers.

Jeffrey A. Nash, Assistant Director
Peterson Air and Space Museum
Peterson Air Force Base, Colorado

Corrections

Dec. 2006/Jan. 2007 Reviews & Previews, caption, p. 70: The lower tank of the Mercury Redstone was filled with alcohol, not kerosene.

Aug./Sept. 2006 "So Many Landing Sites, So Few Landers," Soundings, caption: The image shows Holden, not Horton, Crater.

Apr./May 2006 "Barnstorming the Beltway," Restoration: The person bead-blasting the *Gee Bee's* fuselage in the photograph on page 63 is Laird Smith, not Mike Story.

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Space Age Nostalgia

>>> VISITORS TO CAPE CANAVERAL

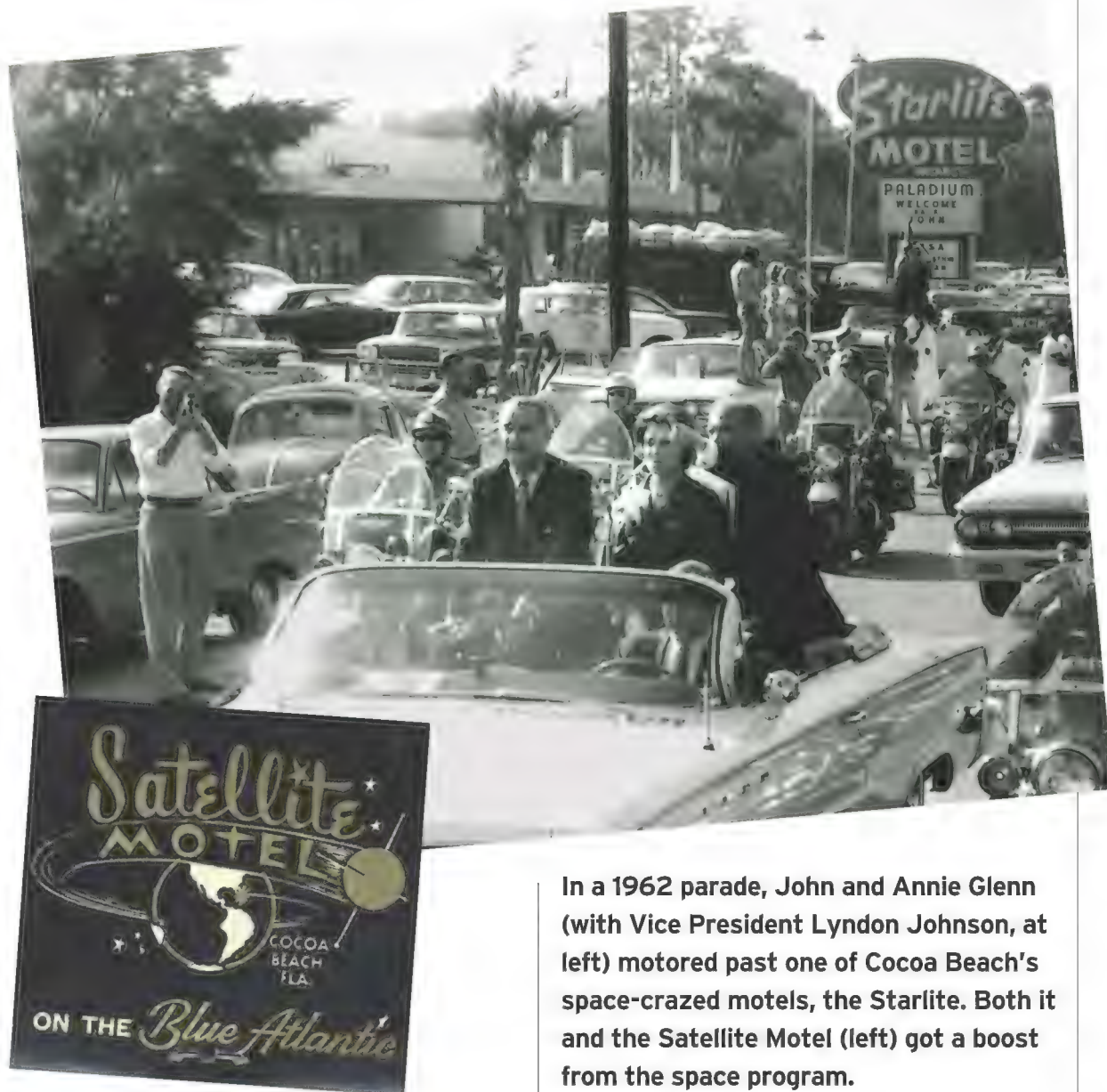
who long to stand in the spot where John Glenn was launched into the history books will have to settle for a tour-bus view of restricted Cape Canaveral Air Force Station. Not that there's much to see. Most parts of Launch Complex 14 have crumbled or been torn down since Glenn's 1962 orbit around Earth. "Really, all that remains is a footprint of what once was," says historian Lori Walters.

But Walters, with her colleagues and students at the University of Central Florida's Institute for Simulation and Training, has devised another way for people to explore the historic site, from the blockhouse to the ready room to the service tower. All it requires is putting on a virtual hard hat at www.capehistory.org, where you can step into Shadows of Canaveral.

With a grant from Florida's Bureau of Historic Preservation, Walters' team used blueprints, film footage, photographs, and the recollections of space workers to digitally re-create Complex 14 down to the smallest detail, such as the color of interior paint and the location of liquid-oxygen tanks.

Visitors to Shadows of Canaveral take on the persona of a reporter for Glenn's hometown paper who has come to cover the launch. Their informative escort is a virtual Cal Fowler. The actual Fowler, technical consultant on the Shadows project, arrived at the Cape in 1957 and became a conductor on pad 14 after Glenn's flight, putting fellow Mercury astronauts Scott Carpenter, Wally Schirra, and Gordon Cooper into space. Though the virtual Cal will watch the launch with the reporter, Fowler actually witnessed it from the beach with his wife and son.

There are no surviving pictures of



In a 1962 parade, John and Annie Glenn (with Vice President Lyndon Johnson, at left) motored past one of Cocoa Beach's space-crazed motels, the Starlite. Both it and the Satellite Motel (left) got a boost from the space program.

the ready room, which housed the launch crew's offices, so Fowler had to sketch its interior from memory. "I've looked at every piece of this and given them comments," he says. "Like 'The Atlas [rocket] isn't sitting on the pad right. You've got to put this there.'"

He also advised the group on its design of the Starlite Motel, which served as press headquarters during Glenn's launch. (Visitors can peek in the reporter's motel room and find the short-lived cartoon show "Top Cat" playing on the TV, a rotary-dial phone on the desk, and Coke in a flat-top can on the reading table.)

In addition to nailing down the technical details, Walters wanted to tell the stories of the average workers who never made headlines. She even tracked down the identity of Hortense Seitner, a legendary driver of "the

roach coach" (as space workers dubbed the food service trucks), who kept popping up as a salty character in people's stories. "Her effort was just as important as Guenter Wendt inserting John Glenn into the capsule, because she kept things oiled and running," says Walters. An avatar of Seitner will soon appear on virtual Canaveral. Though her sailor's vocabulary will be sanitized, Walters predicts: "She'll be a little bit on the gruff side."

A second state grant will help the simulation team move back in time to 1950 to reconstruct Launch Complex 3 and other structures. "You will be able to climb up to the top of the Cape Canaveral lighthouse and look out and see what *wasn't* there," she says. "It will be an interesting glimpse into how fast the Cape developed from a wilderness to a premier launch facility."

SUSAN FRITH

HEADS UP

Air Racing – The World's Fastest Motor Sport

Saturday, February 3, 2007, 10 a.m.
Planes of Fame Air Museum
Cal-Aero Field
Merrill Avenue, #17
Chino, CA 91710
(909) 597-3722
www.planesoffame.org



The Planes of Fame Lockheed T-33 jet trainer, which serves as a pace plane for the Unlimited class at the annual National Air Races in Reno, Nevada, will fly at the February event.

>>> IN THE YEARS BEFORE World War II, aircraft designed specifically for racing represented the cutting edge of aviation technology and inspired the design of military aircraft. About 20 airplanes in the Planes of Fame Museum are for-

mer racers, and the museum owns the T-33 that currently serves as a pace plane for the National Air Races. The seminar will explore the sport's glory days and how air racing contributed to the development of modern military aircraft.

In Memory of Smokejumpers: The Mann Gulch DC-3

>>> IT MAY LOOK LIKE JUST ANY OLD DC-3, but for firefighters it represents a world-changing event. The airplane carried 12 smokejumpers who perished in Montana's 1949 Mann Gulch forest fire. Through the efforts of volunteers and \$125,000 in donations, the twin-engine aircraft that took those men to tragedy—on display at the Museum of Mountain Flying in Missoula, Montana, since its purchase in 2001—was dedicated last October after a thorough restoration. Once its annual inspection is complete this spring, the DC-3 is set to start a flying tour, serving as a tribute to the fallen 12 and a reminder of how hazardous smokejumping can be.

It's an appropriate choice—the U.S. Forest Service still uses DC-3s as jump platforms to this day, says Tim Eldridge, a Forest Service fire information officer and an ex-jumper. Today, Forest Service DC-3s have modern engines and strengthened airframes but are otherwise essentially unchanged since rolling off the California assembly lines of Douglas Aircraft Company in the 1930s.

"The Forest Service acquired quite a few old military airplanes, especially the DC-3 because of its record," Eldridge says. "It's a stout-built aircraft. It does well in mountain flying."

The Mann Gulch DC-3 was purchased after it had retired from the U.S. Army Air Forces in 1946; the new owner was the Missoula-based Johnson Flying Service, winner of the first smokejumper services contract and the service that flew the Mann Gulch fire. The airplane continued working for Johnson until 1974. It ended up in Arkansas, where it was spotted by a former Johnson pilot several years ago. The museum, started by ex-Johnson employees in the early 1990s at Missoula International Airport, bought the DC-3,



Donations enabled the Museum of Mountain Flying to buy DC-3 NC-24320, a survivor of the 1949 Mann Gulch fire, from a cargo hauler in Arkansas.

then flew it back to Missoula for restoration and display.

The airplane represents a watershed event for the Forest Service, according to Eldridge. "It kind of created the whole world of fire science," he says, "so fire was more intensely studied by people from around the world."

It's a special reminder to 95-year-old Earl Cooley, a smokejumper who rode as the spotter on that August day more than 55 years ago. The aircraft makes him think of the men willing to perform a task few people thought was sane.

"I often wondered what I would do...possibly do the same thing again," Cooley says. His Forest Service career, spanning almost 40 years, included 46 jumps from Johnson's fleet of Ford Tri-Motors, Beech Travel Airs, and DC-3s. "I figured I was pretty lucky to live through it."

MIKE HARBOUR

COURTESY PLANES OF FAME

MIKE HARBOUR

Soundings

WORK IN PROGRESS

One Very Red Pitcairn, Comin' Up

>>> Test pilot Andrew King spins up the rotor blades of a rare Pitcairn PA-18 autogyro in New Carlisle, Ohio. Organizers of New Zealand's Omaka Aerodrome airshow have invited the autogyro to their April bash, but before it can fly, owner Jack Tiffany has to track down some paperwork to get it certificated. "The company that owned it in 1939 gave it to a trade school without a bill of sale," King explains. Another glitch: "I had to get a gyroplane rating to fly it, which turned out to be quite an exercise. There aren't many gyroplane instructors in the U.S. or anywhere else." The PA-18 will likely make it to the big Oshkosh, Wisconsin fly-in this summer.



HEADS UP

Gathering of Mustangs and Legends: The Final Roundup

>>> **OF THE 15,000-PLUS** P-51s built, only one percent are flying today. The 1999 Gathering of Mustangs and Legends in Kissimmee, Florida, drew 65 of the iconic World War II fighters. Organizer Stallion 51 Corporation says: Rematch! Expect more than 100 P-51s to migrate to Columbus, Ohio, this fall, with dozens of pilots, crew chiefs, and Women Airforce Service Pilots. The U.S. Air Force Thunderbirds will perform in homage to their F-16s' predecessors. P-38 Lightnings, P-40 Warhawks, and Spitfires will also fly. Look for full coverage in *Air & Space/Smithsonian* this August.

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ANNIVERSARY

The March of the Arrowheads

>>> **TWENTY-FIVE LOCKHEED F-117A** Nighthawks taxied in lockstep and then overflew ceremonies at Holloman Air Force Base in Alamogordo, New Mexico, at the stealth attack aircraft's 25th birthday last October. Nighthawks have collectively logged 250,000 flight hours. The "Wobblin' Goblin," as its pilots called it, came out of the black-project closet in 1981 and drew rave reviews in Panama, Iraq, Afghanistan, and Bosnia. Originally slated to fly into 2018, the 55 active-duty F-117s will instead stand down this year. The aircraft's operational and maintenance funds will be funneled to its replacement, the Lockheed F-22A Raptor.



“When Is an Operating Room like a Cockpit?”

>>> DOCTORS ARE TAKING LESSONS from pilots. Not flying lessons—instead, they’re learning how to prevent hospital accidents by adopting safety techniques used by pilots. Several major hospitals, including Vanderbilt University Medical Center in Tennessee, have hired LifeWings Partners LLC, a group of former fighter jocks and astronauts, to make hospitals as safe as an airliner’s flight deck.

LifeWings president Steve Harden and partner Alan Mullen, both former pilots for Federal Express, got their start in 1992 by training Air National Guard fighter pilots in FedEx’s cockpit crew procedures. Six years ago, the director of a Memphis hospital read an article about them and called Harden. “Right away we were struck with the similarities between health care and aviation,” Harden says. “We watched what was going on in their ER and offered suggestions and tried to adjust their mindset.” The hospital director told another hospital’s director, and business ballooned.

“On a commercial airliner the pilot calls out ‘flaps,’ the first officer says ‘flaps,’ and the pilot checks the flap setting to make sure it’s correct,” Harden says. That’s essentially what LifeWings teaches doctors. One hospital, Harden says, logged a “wrong-site surgery”—performed surgery on the wrong part of the patient—on average every 60 days. LifeWings trained the entire surgical staff to cross-check one another like an aircrew, even running through a checklist posted on the operating room wall. “If the patient is supposed to be John Smith, someone announces it, someone checks his bracelet to make sure and announces it, another checks the medical records and announces it,” he says. “That has fundamentally changed their culture.” As of last December, the hospital has logged 1,200 days without a wrong-site surgery.

PHIL SCOTT

Frank Robinson, Robinson Helicopter

IN 1973, FRANK ROBINSON was a single father raising three children when he quit his job to pursue the dream of designing and manufacturing an affordable personal helicopter. Today, Robinson Helicopter Company is the world’s most prolific producer of civilian helicopters. What began with one engineer working at his kitchen table has evolved into 1,200 employees working in a 480,000-square-foot plant in Torrance, California. At 76, Robinson pilots one of his own helicopters almost every day.

What sparked your interest in helicopters?

I was nine years old when I saw a newspaper picture of a Sikorsky VS-300 prototype hovering. I was intrigued that someone could make a machine that could stand motionless in the air. When I entered college [Robinson studied mechanical engineering at the University of Washington and did graduate work in aeronautical engineering at the University of Wichita], I took courses that would help me design a personal helicopter. When I got out of college in 1957, I joined Cessna as a flight engineer because they were making a small personal helicopter called the Skyhook. The Skyhook turned out to be a very sophisticated machine—in my view because Cessna wanted to get Army money—and in my view that was a mistake. It created reliability problems.

When did you decide to build your own helicopter?

I started working on it before I graduated from college and kept at it while I worked for other companies. I bought machine tools and riveting equipment and set up workshops in my basement or garage, where I did a lot of experimenting. I was married at that time and it always created a bit of conflict—whether to spend money on an engine lathe or new drapes for the house. I continued to pitch the idea of a small, two-seat personal helicopter at just about every company I worked for, but I could never convince them. They were making a lot of money building large, expensive, and overpriced helicopters for the military. I was working on the Apache program at Hughes in 1973 when I decided to leave. That was the start of the dark years.

Why have you stuck with piston engines when just about every other helicopter manufacturer uses turbines?

If I were building a high-performance military helicopter, hell, I’d put a turbine in it because you don’t care about costs. But for private use, piston engines have all the advantages: low costs, low operating expenses, and low fuel consumption. They have never been able to build a small, lightweight turbine that is as fuel efficient as a piston engine. A lot of people were exchanging [turbine engine] Bell JetRangers for our helicopters even before fuel prices went crazy.



COURTESY ROBINSON HELICOPTER COMPANY

Frank Robinson and his rotorcraft of many colors.

In the Museum

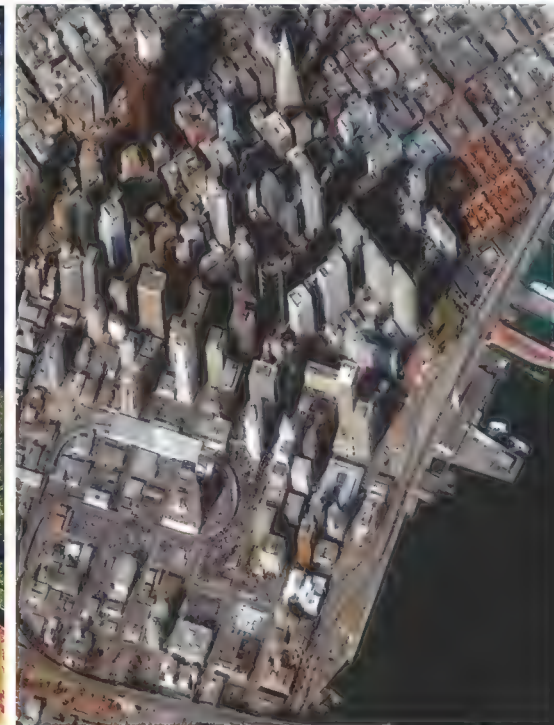
STOPS ON A TOUR THROUGH AMERICA'S HANGAR

On a Clear Day, You Can See Forever

IT HASN'T BEEN THAT long since the first images of Earth were taken from space. A V-2 rocket launched from the White Sands Proving Ground near Alamogordo, New Mexico, and equipped with a movie camera



Andrew Johnston (left) teaches eager kids about satellites. Above left: Russia's Lena River Delta seen by Landsat 7 and (right) IKONOS' view of San Francisco.



nine animations of satellite imagery flash at a rapid pace. "The globe demonstrates how we use satellites to track various global phenomena," Johnston says. "All the images we chose for the exhibit were selected to educate people about the different kinds of images available, but we also wanted them to be beautiful."

The satellite images are so colorful due to the manner in which geographers process them. Remote sensing satellites use both visible and infrared wavelengths to read the surface of Earth. Data from the satellites are stored as numbers, each of which is represented by one pixel, or picture element. Each pixel is assigned a brightness value, and then the person responsible for creating the final image chooses various colors to correspond to the brightness values. "The images are intentionally processed to be pretty," Johnston says. "The colors chosen are usually selected because they accent a particular element of the landscape: a certain

captured grainy black-and-white images of our planet on October 24, 1946. Just 60 years later, a technique called remote sensing enables the average person to search the Internet for crystal-clear images of his own house, taken by satellites orbiting miles above Earth.

A new traveling exhibit called "Earth from Space," based on a book by Andrew Johnston—a geographer at the National Air and Space Museum's

Center for Earth and Planetary Studies—is taking those now-familiar, high-resolution satellite images of Earth and displaying them in all their glory. "These images give people an idea of the diversity of satellite remote sensing products," says Johnston, pointing out the displays within the exhibit, now at the Museum.

A little girl no older than four is immediately attracted to a colorful globe, the Magic Planet, across which

LEFT: ERIC LONG; ABOVE LEFT: U.S. GEOLOGICAL SURVEY; ABOVE RIGHT: IKONOS SATELLITE IMAGE BY GEOEYE

type of vegetation, or the presence of forest fires or water.”

Scientists in a variety of fields rely on the images for more than their beauty. Biologists and ecologists are interested in an image of the Florida Everglades that details types and density of vegetation. Meteorologists track weather patterns by watching color variations on maps of the oceans. And geologists look closely for changes in the topography of mountain ranges and deserts.

The exhibit is divided into The Living Planet, Water and Air, Structure of the Land, and The Human Presence. The images in the Living Planet section are vivid representations of Earth’s plant, animal, and mineral activity. Water and Air looks at the effect of the atmosphere and climate changes on Earth, while Structure of the Land examines the constant shifting of landmasses. The Human Presence shows images of the impact the human race has had on Earth, from busy centers of commerce to the deforestation of the Amazon. “There’s no judgment in these images,” says Johnston, indicating two images of the Amazon side by side. One was taken in 1976, the other in 2001. The amount of forest that has been clear cut to make room for housing and industry is striking. “People can read what they

[Visitor Information]



Curator’s Choice National Air and Space Museum curators occasionally give 15-minute talks about an artifact or subject of interest at the Steven F. Udvar-Hazy Center in northern Virginia. Meet at the nose of the SR-71 Blackbird aircraft at 12:30 p.m. Feb. 1, Suits That Never Flew: NASA’s Advanced Extra-Vehicular Activity Suit Program; Feb. 15, The Curtiss F9C-2 Sparrowhawk: The Plane on the Flying Trapeze; Mar. 1, BD-5: Too Good to be True; Mar. 15, Dining in Space à la Russe.



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Docent Tours Learn about the Museums’ collections and trace the history of air and space travel on free, docent-led tours. At the Museum on the Mall, tours meet at the Welcome Center. At the Udvar-Hazy Center, tours meet at the Docent Tours desk in the Boeing Aviation Hangar. Tours run daily at 10:30 a.m. and 1 p.m.



Bus Service The Virginia Regional Transportation Association offers convenient shuttle bus service between Washington Dulles International Airport and the Udvar-Hazy Center. Visit www.vatransit.org and click on “Bus Routes,” then “Air and Space Museum shuttle.” Shuttle service between the National Mall building and the Udvar-Hazy Center has been discontinued.

want into these two pictures. We’re just here to show the difference 25 years has made.”

About a dozen satellites’ images are represented in the exhibit. The satellites belong to a variety of organizations, and have been orbiting Earth for various periods of time.

The next stop for “Earth from Space” is Georgia Highlands College in Rome, Georgia. At the end of March, it moves to the Virginia Air and Space Center in Hampton for a couple of months. The exhibit will tour the country for the next three years.

 BETTINA H. CHAVANNE

ARTIFACTS

Littlest Fighters

THE CONCEPT OF AN AIRBORNE aircraft carrier may sound impossible, but in the 1930s, there were two of them. The USS *Akron* and *Macon* were dirigibles that tiny Curtiss F9C-2 Sparrowhawk aircraft were launched from and recovered by. Until the *Akron* went down in a storm in 1933 and the *Macon* crashed in 1935, the Sparrowhawks had never had an accident. Curtiss built eight Sparrowhawks as airship-based fighters in the lighter-than-air division of the U.S. Navy.



DANE PENLAND

This petite powerhouse sits in the Steven F. Udvar-Hazy Center. The pilot used the hook at the top of the Sparrowhawk to attach his aircraft to a dirigible after a mission.

Mrs. Whitley and the Victor

I WAS A VERY YOUNG and ignorant aerodynamicist when I worked in the research department of Handley-Page Aircraft in England. It was in the mid-1950s, the hottest period of the cold war. We built a graceful, sickle-winged, and rather eccentric Royal Air Force bomber called the Victor, which was specifically designed to drop nuclear bombs on Moscow, which seemed, at the time, like a sensible thing to do.

The plant was in a Dickensian factory sprawling across the London suburb of Cricklewood. The aircraft were built in great echoing hangars at ground level while upstairs was a rabbit warren of tiny offices. One of these, the calculator office, was commanded by Mrs. Whitley.

This was in the era before computers, when calculations were done by a team of bright young women operating massive green, dented Friden mechanical calculators. The women would set rows of 10-digit numbers by hand, then pull a heavy lever, like that on a Las Vegas one-armed bandit. It went *kerchunk, kerchunk* above the cheerful chatter, and the little numbers rotated like those on an odometer. Mrs. Whitley maintained severe matriarchal control over her “girls,” as she called them. Pairs of girls, sitting on opposite sides of the room, made identical calculations for each step, and Mrs. Whitley cross-checked the results. They never made a mistake.

Each morning I would walk through the calculator office on the way to mine. I would always say, “Good morning, Mrs. Whitley, and how are your calculating young ladies this morning?”

She never replied, but obviously brooded on my arrogance. I think the

“young ladies” enjoyed the greeting, but not Mrs. Whitley, which was the main reason I did it.

The director of research was a distinguished and elegant European designer, Doktor Gustaf Lachmann. He had had a classic career. I was told by co-workers that he had flown in a fighter squadron, a famous *Jagdstaffel*, and studied at Göttingen, where the well-known aerodynamicist Ludwig Prandtl presided. Lachmann had hated the Nazi party, defected, and become a British subject in the 1930s, designing aircraft to bomb his homeland.



Handley-Page presents: the Victor B Mark II.

He was very kind to me, perhaps because he sensed that I held him in such awe. He regaled me with harrowing tales of his aerial escapades on the Western Front in the First World War and, even more hairy, his earlier battles as a cavalry officer on the Eastern Front. Wounded by a tactic he considered most unsporting—machine guns versus horseflesh—he received a transfer to the Imperial Air Force. Many cavalymen forsook the steed and took to the skies, greatly reducing their chances of survival but also significantly increasing their attractiveness to the fairer sex. It was a reasonable exchange, Lachmann assured me.

The latest Victor, the Model B, Mark II, exploited a special maneuver. It would pull up into a steep climb, pitch its deadly ordnance in the direction of Moscow, and then “beat it,” as the Royal Air Force put it. This extreme launch maneuver imposed heavy loads on the wing, and the outer panel had to be redesigned to simplify the operation. I, a boy fresh out of graduate school at the California Institute of Technology, was ordered to do this man’s job. It involved

designing a new airfoil, the beautiful cross-section of a wing. Using what were then advanced mathematical procedures, based on the methods of scientists Dietrich Küchemann and Johanna Weber, I drew up a shape that I thought would be satisfactory. Massive calculations were needed to find the pressure distribution on an airfoil, a job for Mrs. Whitley. I carried the long list of numbers defining the shape, called ordinates, into her office and asked her to do the computations.

Two weeks later, Mrs. Whitley presented me with a huge table of hand-written numbers, within which the pressure values were embedded. I returned to my office and leaned over a drawing board to plot the pressure. It looked rather funny. Near the front, on the top of the airfoil, Mrs. Whitley had predicted a huge negative pressure peak. It looked like Vesuvius rising from the plains. I took the graph

into Lachmann's office. It was obviously unacceptable, but that was for him to decide. As had been the case in his old *Jagdstaffel*, he made all the decisions for the research office.

"This will not do," he said.

"Yes sir, I agree."

"You must fix this, Lessmann," he hissed in his distinctive accent. One could hear the double "n" as he made my Cornish name sound totally Teutonic.

"What do you suggest, sir?" I asked meekly.

"That's for you, Lessmann. You have zis advanced degree from America."

"Yes sir, I'll do my best."

I had no experience, and didn't know that in engineering one is almost invariably wrong the first time. One of the older chaps, who knew wing design, came to the rescue. He had nothing like my credentials, but ten times my common sense.

"Can't possibly be that way, Peter. The bloody girls have got it wrong."

With this heretical thought, I returned to Mrs. Whitley. This was a sensitive matter, so I tried to be tactful. "Is it possible, Mrs. Whitley, that there could be some small error here?"

"No, Mr. Lissaman, it is not possible. My girls have never made a mistake."

She slammed the door shut. I couldn't check two weeks of massive calculation by six pairs of calculator operators myself. It worried me, especially as Lachmann asked me every day how I was progressing.

One day, inspired by the delightful spring weather, it occurred to me that maybe the girls were right too. I checked the shape of the airfoil used for the calculations. A revelation! One of the ordinates, just where the pressure had been so uncouth, was listed as 9.243 instead of 2.943. So that was what had given the airfoil a huge lump.

I dashed over to Mrs. Whitley.

"Mrs. Whitley, your girls made a mistake. They used 9.2 instead of 2.9!"

"They wouldn't have done that, Mr. Lissaman. They never do."

"Well, it doesn't matter who did it. Let's just change the numbers and re-calculate."

"No, I don't think my girls should do that, Mr. Lissaman."

"Well, I wish you would, Mrs. Whitley. Please consider the thought."

Three days later I went back. Mrs. Whitley was adamant. "They did it right the first time, Mr. Lissaman," she said, "and

the answer's the same. They did it just the way you yourself said."

Triumphantly she produced the original input sheet. There, in my own handwriting, was the horribly wrong ordinate: 9.243.

"You wrote it like that," she said. "My girls did it right, and they're not going to spend another two weeks and miss their tea just because you changed your mind." The long-suffering Mrs. Whitley had arrived at her sweet moment of revenge.

It was, literally, back to the drawing board. I sharpened some 6H pencils, leaned over the board, and laid out the airfoil shape I had specified. It had a huge bump on the top. There it was, large as life—a colossal excrescence in what was supposed to have been a streamlined contour. I took the ridiculous airfoil shape to Lachmann. It was up to him to decide.

"What do you think of this airfoil, sir?"

"Horrible, horrible, Lessmann," he declaimed. "That must be the problem."

"Yes sir, that's what I thought it might be."

"Well, we'll just have her change it."

"An excellent idea, sir, but I'm afraid she won't."

"She won't! Why not, Lessmann?"

"She says she did it right the first

time, sir. She refuses to do it again. At least not for me."

"Since when was Mrs. Whitley designer of the RAF nuclear bomber force?"

"Since this morning, sir."

"Come with me, Lessmann."

We marched back to the calculator office, with me one respectful step behind the great man. Mrs. Whitley was all aflutter with pride and gratification. "What can we do for you, Dr. Lachmann?"

"Well, it's this ridiculous airfoil Lessmann brought you." She eyed me vindictively, delighted that he had dropped the "mister."

"It is totally unsatisfactory. But, as a result of your careful calculations, I have an idea for an improved design."

"The girls will be very proud of that, Dr. Lachmann. They worked so hard on this."

"So, I will send Lessmann in with my new design."

"We'll be honored to do it for you, Dr. Lachmann."

When we got to his office, he said, "Take them in some new ordinates, *und, Gott in Himmel*, make them *schlicht*." I knew the German word from my Caltech days. It meant very smooth, to a special degree. I complied, and sent the new airfoil back.

Mrs. Whitley's pressures on the new, smooth shape looked perfect, an airfoil designer's dream. It was really astonishing good luck, but, in my youthful ignorance, I thought it a direct result of my applying what I had learned in graduate school.

The wind tunnel tests confirmed the shape's excellent behavior. It was decided to use the airfoil on the wing of new models of the Victor.

Aerodynamicists like to sign their work—after all, airfoils in those days were an art form. I asked Lachmann if I could put my name on the Victor's new airfoil.

"That will not be necessary, Lessmann," he said, as though he were replying to a butler's offer of another brandy. I could not respond. Those were authoritarian days.

 PETER LISSAMAN

This was in the era before computers, when calculations were done by a team of bright young women operating massive green, dented Friden mechanical calculators.

Flights & Fancy

WHIMSY, NOSTALGIA, AND JUST PLAIN MISCHIEF

What I Learned From Wrong Way Corrigan

FOR A 14-YEAR-OLD airplane fanatic in 1938, my home was ideally located: directly in line with the principal runway of the Detroit City Airport and two blocks from the boundary fence.

I loved to wander the airport, with its yellow brick hangars and busy passenger terminal. American Airlines had recently phased out its lumbering Curtiss Condor biplanes, replacing them with the new Douglas DC series. Penn Central (now United) acquired a fleet of Boeing 247Ds, beautiful all-metal jobs with air-conditioned cabins. At the far end of the field, Barkley-Grow was constructing its twin-engine, all-metal transport, which resembled the Lockheed Electra.

That year I attended summer school to get a head start on the upcoming 10th grade. My walk to school passed a corner newsstand. On the morning of July 18, bold headlines caught my attention. Douglas Corrigan, an unknown California aviator, had flown solo from New York to Dublin, Ireland, in a 1929 Curtiss Robin. He had been denied permission to make the flight but had done so anyway, claiming a compass error had caused him to head east rather than west to Long Beach, California, his supposed destination. He arrived in Ireland without a passport or permission to land, but, being a transplant from the *ould sod*, was given a hero's welcome.

In the following days, newspapers and radio stations were brimming with details on the pilot now known as "Wrong Way" Corrigan. Upon returning from Ireland, Corrigan toured the nation. When he visited



Detroit, I was there, along with thousands, to greet him.

After World War II began, and shortly after my 18th birthday, I joined the Army. When the war ended, I acquired an airframe-and-powerplant mechanic's license and started working toward a commercial pilot's license. In 1950, I was attending a navigation class, held in an old Quonset hut at Culver City Airport in a Los Angeles suburb. The instructor was lecturing on planning a cross-country flight and stressed the importance of studying weather reports to compensate for winds aloft, high- and low-pressure areas, and adverse weather. Spotting someone through the window at the rear of the room, he shouted, "Doug! Doug! Come in here!" A moment later, a slim fellow with a boyish face entered the room. "Here's someone to tell you about navigation. This is Doug Corrigan." Some of my classmates had no idea who he was.

After the instructor enlightened the class, the questions began. "Did you really mean to fly to Ireland?" "Did the government prosecute you?" "Where is your airplane now?" Corrigan

steadfastly denied that he had planned to cross the Atlantic. He explained that his only navigational aid had been an earth inductor compass. To use this device, a dial is rotated to indicate the desired heading. The pilot then simply steers the airplane, keeping the needle centered, to fly the proper heading. Charles Lindbergh used such a device in his historic transatlantic solo flight, 11 years before Corrigan's trip. Corrigan claimed that the heading from Long Beach to New York is very close to the heading from New York to Dublin, and that he had simply forgotten to change the setting from the one he had used to reach New York. It sounded legit to me.

The instructor asked Corrigan to give us some tips on navigation. He grinned. "I don't worry about winds, high- or low-pressure areas, or any of that stuff. On long trips, they all cancel each other out. I just go to my cruise altitude, figure how long it will take to get there, and let down when the time's up. I always hit it within a few miles."

Somehow, I don't think that was what the instructor had in mind.

DIRK WOESTENBURG

DAVID CLARK

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That Old-Time Profession

The airplanes are faster and the power lines more plentiful, but cropdusters fly today just as they did in the 1920s.

by Tom Harpole

WE ARE TEARING ALONG AT 120 MPH ABOUT SIX FEET ABOVE THE GROUND

in Mark Edwards' Citabria. Ripe cotton brushes the landing gear, and the field is a dirty white blur. "You want leaves in your brake calipers when you land," Edwards says matter-of-factly on my headset. The Mississippi cotton field is bordered by dirt roads and outlined with rows of trees, fences, and more power lines and utility poles than I've noticed anywhere before. Silos, sheds, and barns jut ominously. When you're looking for potential obstructions, cell phone towers and radio antennas held erect with near-

ly invisible guy wires seem to multiply.

Edwards, an agricultural pilot with 16,000 hours, calls my attention to the power lines that cut across the field about a quarter of a mile ahead. We're closing in on them at roughly 200 feet per second. This is like "slow mo," he says, compared with his turbine-powered Air Tractor, which he flies all day long at 140 mph. But the Air Tractor doesn't have a passenger seat, so he's using his two-place Citabria to approximate for me what cropdusting is like.



GRANT/DCP, INC.



NASM (SI NEG. #91-723)

In a turbine Air Tractor, Mark Edwards is more protected and sprays more precisely than the pilot leaving a cloud behind a 1924 Huff-Daland Duster (above).

er lines. They spook at the last second.”

Aerial application, as cropdusters like to call their trade, is barely aerial. The lower the airplane flies, the smaller the chance the chemicals it disperses will drift away from the target crops and the greater the chance the target will be covered evenly. Mark Brown, an ag pilot in central Washington, says he flies 10 or 12 feet above the ground “so the product mixes in our airflow instead of individual streaks hitting the ground. Too high, you get drift. Fifteen feet can be too high. You take what the wind offers.”

Short of combat flying, there probably isn’t a more demanding mission for pilots and aircraft than spraying crops. I’ve heard stories of ducks flying up into airplanes from Louisiana rice paddies, horses that suddenly stand from a slumber in tall Mississippi cotton, fence posts that appear in inconvenient locations, and any number of mishaps, mid-air, near-misses, and forced landings.

A 2002 Federal Aviation Administration report noted that the accident rate for agricultural operations is higher than the overall accident rate for general aviation, yet the fatality rate is lower. Ag pilots and the makers of the airplanes they fly have learned to manage a workplace crowded with things to run into. Safety features include wire cutters in front of the windscreen to keep a pilot who has run into a power line from being decap-

itated. Cockpits have strong harness systems, collapsible structure in front of the pilot, low-positioned instrument panels, and an energy-absorbing seat. But ag planes didn’t start out that way.

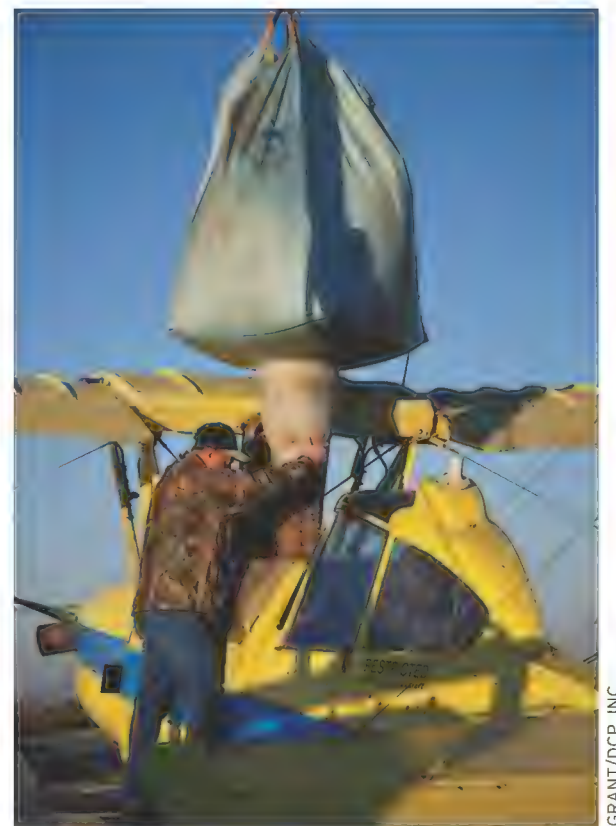
The Edwards brothers, Mark and Bubba, grew up on a farm less than a mile from their fixed-base operation, Edwards Flying Service, which comprises two hangars, tanks, sheds, a 3,400-foot runway, and a concrete pad, where they mix and load chemicals. They are hefty, pleasant, unflappable pilots who rarely fly above 500 feet or more than a few miles from their strip. They aren’t instrument-rated and don’t want to be, and they can’t imagine wanting to do any less challenging kind of flying. Like all ag pilots, they avoid obstacles (or not) all day while precisely spraying dozens of 3,000-pound loads of expensive chemicals, seeds, and fertilizers from airplanes that are designed to withstand 50 or more takeoffs and landings and a couple of hundred tight, fast turns a day, day after day.

From a dirt strip next to the Edwards’ farmhouse, John “Bubba” Edwards Sr. flew a war-surplus Stearman with a 55-gallon drum strapped in the back seat that was plumbed to spray crops. The brothers went to a cropdusting school because Bubba Sr. was self-taught and didn’t feel he’d be a good instructor, but they grew into ag aviation under his tutelage. “Daddy’d watch us fly neighbors’ fields and talk to us afterwards,” Mark recalls. “He’d tell us things like: ‘Drive around every new field and look for wires before you fly it’ or ‘Put the throttle to the firewall. Those planes can take it’ or

As we pass under the wires, I duck and curse reflexively. “Make you duck?” Edwards asks. “I do sometimes.” He pulls up short of some trees, points the nose at the oyster-shell sky, then rolls the airplane over on its left wing and dives back down at the cotton field. He levels out, seemingly inches above the ground, and does the power line limbo again. “You gotta stay composed doing that,” he says. “Real hot days the wires stretch and droop. Ones you fit under before can go lower.” He makes another turn, then says, “You get bird strikes around pow-



NASM (SI NEG. #90-13794)



GRANT/DCP, INC.

When Piper introduced its Pawnee in 1959, ag aviation was big business. An early industry startup was the 1920s forerunner of Delta Air Lines (below).

‘Look way out ahead; don’t get stuck staring.’ We grew up living and talking flying.”

On any given summer morning across the country in the postwar years there would be as many as a thousand Stearman cropdusters in the air. Stearmans served as primary trainers for the U.S. Army and Navy and the Royal Canadian Air Force, and by the end of World War II more than 10,000 had been built. The ones that survived their student pilots were sold as war surplus for as little as \$250. For a generation, they were the standard of the industry, and a handful still fly. The Stearman didn’t have an energy-absorbing seat, but it was stable and friendly and allowed new pilots or low-flying cropdusters to fly out of most of the mistakes they could make. A Stearman A75 equipped with a 450-horsepower Pratt & Whitney engine occupies a place of honor at the National Agricultural Aviation Museum in Jackson, Mississippi.

Cotton dusting around Leland, where the Edwards brothers work today, was al-

ready a tradition when the war-surplus Stearmans showed up. By 1930, farmers in the Mississippi Delta were learning about aerial experiments conducted by the U.S. Department of Agriculture’s Delta Laboratory in Tallulah, Louisiana. The laboratory was a sworn enemy of the boll weevil, which was causing millions of dollars’ worth of cotton losses annually, and its director, entomologist Bert Coad, was fascinated by airplanes. (So was his assistant, C.E. Woolman. Woolman later founded a dusting operation, Delta Flying Service, which eventually became Delta Air Lines.) Coad had been impressed by the 1921 flights of Army Captain John Macready, who

spread lead arsenate on a grove of moth-infested catalpa trees near McCook Field in Ohio from a war-surplus Curtiss JN-6H Jenny. Until then, cropdusting had been a laborious and brutal process. Macready accomplished in 54 seconds what would have taken two men with a wagon and a team of mules a week to do.

By August 1922, Coad had hired World War I veterans to fly two Jennys and a surplus de Havilland DH-4B in hundreds of test flights over delta cotton fields. The heedful young Army pilots evolved techniques to prevent chemical drift, the cropduster’s perennial hassle, which required constantly “playing” surface winds and fly-

ing low and slow. The lab added a venturi in front of the hopper to provide ram-air pressure to blow the dust out a six-foot-wide dispenser fastened under the aircraft, mercifully replacing mechanics who had been crouching in back seats, operating the hoppers with a hand crank.

In 1923, George Post, pilot and vice president of the Huff-Daland Aircraft company, also learned of the test flying the U.S. Department of Agriculture laboratory was conducting. Two years later, Huff-Daland had redesigned its Petrel 5 airplane and had begun building the Huff-Daland Duster, a fabric-covered biplane powered by the 200-horsepower Wright J-4 Whirlwind radial.

Other manufacturers saw the potential in ag aviation after the war, and in the 1950s and ’60s four new airplane types would dominate it: Grumman Ag-Cats, Piper Pawnees, Rockwell-Standard Commander Thrushes, designed by Leland Snow, and Snow’s Air Tractors. These would become the basis of the multimillion-dollar, 3,500-airplane industry cropdusting has become today. Snow, 77, has seen more than 2,000 Air Tractors alone roll out of his facility in Olney, Texas, since he started manufacturing them in 1958.

For more than 55 of the 85 years of cropdusting history, Leland Snow has been the major contributor to the development of “flying farm equipment,” as he calls his airplanes. Snow’s designs, which inspired other ag plane makers, incorporated a tubular steel framework that includes a roll cage to protect pilots in mishaps.

Former rice pilot Don Waguespack, whose career spanned the gamut from



NASM (SI NEG. #00144037)

Upgrading from a war-surplus Stearman (below) to a purpose-built Grumman Ag-Cat (opposite) hasn't changed the nature of one cropdusting chore. Ag pilots still have to land as often as every 10 minutes to reload the hopper.



HANS GROENHOFF PHOTOGRAPHIC COLLECTION/NASM (SI NEG. #2003-33190)

Stearmans to GPS-equipped turbines, knows first-hand how important cockpit protection can be. By the time he retired, at 66, “Wag,” as he is known throughout Louisiana rice country, had become a legend, having survived more forced landings than he can recall and walking away from three airplane wrecks. His worst, he says, was in a 450-horsepower Grumman Ag-Cat. “They had overloaded the airplane with fertilizer and didn’t tell me,” he recalls, “so after I took off, I couldn’t make it over the line of trees at the end of the runway.” The wings tore off as the Grumman shouldered through the treetops and went in head first. When the airplane hit the ground, the engine broke away and Waguespack jumped out into a pool of avgas, happy there was no electrical system in the airplane to ignite a fire. He was also happy he hadn’t been flying the Stearman, an airplane, he says, that “was not designed for that kind of work or that kind of wreck.”

CROPDUSTERS WORK IN A hierarchy of hazards, starting with the maze of obstacles they fly through and progressing through the farmers’ constant antagonists: time and weather. In the rice farming states—Louisiana, Mississippi, Arkansas,



GRANT/DCP, INC. (2)

Even with a crash helmet and safety harness, Butch Dehart (above) is watchful during turns. Vigilance is wise; cropdusters share the airways (right).

Texas, and California—every phase of rice production except the harvest is accomplished from the air. The most critical is planting. When the sprouted rice is ready, it must be aerially seeded in the flooded paddies within hours. “It doesn’t matter what the weather’s doing, the farmers have a small fortune tied up in the sprouts and we have to get it planted,” says pilot Butch Dehart. A muscular 45-year-old, Dehart grew up on a farm a couple miles from Ken Guidry’s Victory Flyers, near Abbeville, in southwest Louisiana, where Waguespack worked for years. Dehart speaks paternalistically about “his” farmers in his corner of Vermillion Parish, most of whom he’s known all his life. “They’re spoiled,” he laughs. “They pick up the phone and know we’re going to take care of their crops.”

The worst flying and landing conditions often coincide with the rice planting season, but rice pilots can’t wait till the weather clears. When the demands of the rice season required flying on rainy days, farmers would send fuel and loader trucks to parish roads surrounding the rice farms to refill the ag planes. “We need blacktop runways because the dirt strips are just mud,” says Dehart. Parish deputies would hold traffic until the pilots could land, fill up, and take off again, but for the last few years, Dehart explains with a hint of rancor, it’s up to the pilots and farmers to block roads so they can land for refu-



eling and reloading their hoppers.

When ag plane builders started equipping their products with turbine engines, the cropdusting life got easier. Victory Flyers owner Ken Guidry, who was a cropduster for 46 years, since he was 19, modified his fleet with turbines in the 1980s, and at one time owned five turbine Ag-Cats. “I never dreamed anyone would have that much, let alone me,” he says today. “Everything got faster, safer, more fun, and paid better,” recalls Waguespack. “One turbine-powered spray plane can do more than twice what a radial-engined plane could.”

“When you’re turning, you ain’t earning,” Waguespack continues. “You make your pass, close your hopper, and your first move is downwind, nose up, to bleed off speed.” I ask him if that’s called a “P” turn or a “hammerhead.” He shrugs and says: “I call it the get-back-down-on-the-field-as-fast-as-you-can turn.” Cropdusters repeat that pattern hundreds of times a day, between landings and takeoffs every 10 minutes or less to refill the hopper.

The public feels a sort of general un-

The Dromader M-18A is Gary Hubler's other airplane. He also races a Formula One speedster, which holds the course record at Reno, Nevada, where, he says, his cropdusting experience gives him an edge.



JIM RAEDER

ease about the chemicals the ag pilots spread. GPS has improved the precision and efficiency of spraying, but chemicals can still drift, and the practice of cropdusting has grown controversial. "People waved to us 30 years ago," says Waguespack. "Now we look out for guys with shotguns." To avoid drift, Louisiana pilots ground themselves when winds exceed 10 mph. "Dust devils or strong gusts crossing over trees could throw you out of the plane if you weren't strapped in," Waguespack claims. "It only throws you around for a second or two, but at 30 feet of altitude that can spoil your day."

THE WINDS THAT PITCH and plunge, often unpredictably, out of Washington state's 10,000-foot Cascade Mountains are day spoilers for northwestern ag pilots. The Quincy Flying Service's hangars and paved strip reside in the lee of the Cascade foothills. In central Washington, where the foothills finally flatten out, hardened volcanic flows intrude through thin soil and make farming difficult. The farmers manage with the help of irrigation pivots, watering booms that look like fallen radio towers mounted on tractor tires. Center-pivot irrigation fixtures have turned Grant County into the "second biggest potato-producing county in the U.S.," signs on Highway 2 brag.

Two dachshunds, a terrier, and Rick Weaver, flying service owner and pilot, greet visitors at the hangar office. Weaver employs two pilots to do the spraying: Mark Brown, 38, and Dave Mickelson, 48. Over the years, the Weavers have owned six Pawnees, two helicopters, and an as-



NASM (SI NEG. #USAF-10870AC)

The birthplaces of ag aviation: Mississippi cotton fields (above) and the old terminal at Louisiana's Vicksburg/Tullulah Regional Airport (right), still a dusters' depot.

sortment of smaller "recip planes," which they have now replaced with turbine-powered Air Tractors.

The Columbia River defines the western edge of Grant County, and two-inch-thick cross-country power lines, carried in sets of eight by towers 12 stories tall, radiate from the many hydroelectric dams like strands in an enormous metal web. Fiber-optic lines have been hung beneath the power lines. More wires to new irrigation pivots and commuter ranchettes show up every year, in addition to the hundreds of phone and electric lines that serve crossroads communities and farms. Grant County looks to be embroidered with more wires per square mile than any place in the United States.

Among Grant County ag pilots, a conventional wisdom has developed about how to survive wire strikes. Mickelson's advice: "You can't break a cross-country wire with your landing gear, so hit the wire square with your prop, so you cut it," which Mickelson did, just seconds before totaling an Air Tractor a few years ago. "I was looking at the wires a couple hundred feet ahead and forgot about the one right in front of me," he says. "I got my prop into it and cut it. I swapped some airspeed for maybe a hundred feet of altitude. My windscreen was covered with



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oil, but out the side I saw a chance to clear a hundred-foot-tall poplar windbreak and land uphill in an apple orchard between the rows." From the moment he hit the wire until he climbed from the wreckage, perhaps a minute elapsed.

Like a lot of cropdusters, the Quincy pilots talk about ag flying as though it were motocross riding or extreme skiing, where the speed and time in the air and the split-second decisions and the equipment they're riding are always manageable if not exactly under control.

Perhaps the most perilous job in ag aviation is the night spraying that Gary Hubler, near Boise, has done for most of 31 seasons. Seed crops such as alfalfa in Idaho's Treasure Valley must be pollinated by bees. Hundreds of beehives are trucked into the valley for the seasonal job. Insecticides sprayed during the day would kill the bees, so the crop sprayers work at night, after the bees have made it back to the hives. About 30 percent of his flying time, Hubler takes to the night skies. He shrugs off the danger. "You develop night vision," he says. "But when you're going under power lines and over trees, a good memory of where the obstructions are



GRANT/DCP, INC.

One of the few classes of pilots who don't fly to get somewhere, cropdusters build thousands of hours in a few square miles.

from seeing the field in daylight helps a lot. It's usually smooth; the winds die down at night." Hubler, 52, is tall and slim with a rolling stride. He flies Polish-built Dromader M-18As, a monoplane design derived from Leland Snow's S-2.

Hubler's father was a cropduster for 21 years. His brother Dan, also a cropduster, died in 1986 when he clipped a power line while he was spraying at dusk, a mishap, as Hubler explains it, that Dan had avoided "a million times." Hubler shakes his head slowly. "For a while I flew freight, and didn't know if I'd go back to the job that killed my little brother."

AG PILOTS DON'T grow on trees. Many in the profession are retiring, and there are only a handful of schools around the country to instruct new pilots. One of them, Ag Flight in Bainbridge, Georgia, graduates as many as 40 students a year, but they can become ag pilots only after established operators bring them up through the ranks, sometimes starting them off as loaders or other ground-crew positions. The fine points of cropdusting

continue to be passed along, for the most part, by word of mouth, just as John Edwards instructed his sons how to spray cotton around Leland, Mississippi. And because a turbine-powered ag plane can cost well over half a million dollars, insurance companies often request a training syllabus from operators before insuring the aircraft. "You have to be real persistent to break into ag aviation," according to Jerry Miller, an instructor at Ag Flight.

In that way, the profession hasn't changed so much. It was tough to break into the business when Don Waguespack was trying in the early 1950s. "I always had the urge to fly, since I was about 12," he says. "I wanted to learn but I didn't know how I would go about doing it." He got a job loading trucks for the air service that sprayed his father's rice farm, and with a loan from his uncle, he bought a Piper Cub Special and got his pilot's license. "Then the owner of the air service gave me the chance to fly," he says. "Flying low like that—it was exactly what I imagined." Ken Guidry had a similar experience: "I started with nothing, and I made a lot of money, and it was fun," he says. "It never seemed like a day's work."

For the determined, Jerry Miller be-

lieves, there are jobs today. "I hear every day about some operator who needs to replace a retiring pilot," Miller says. "Fifteen years ago there were no job openings. Today a new pilot can earn 90 dollars per hour spraying boll weevil in the southeast. I don't know about other regions and crops, but the jobs are out there." He pauses, then adds, "When they quit building John Deere tractors, they can quit building ag planes."

When I asked Gary Hubler about retirement, and if he could sell his business, he said, "I'd have to get a cheap plane and break a young guy in like my Dad did me. Get his hours built up, watch him fly, and talk to him about all the ways to avoid getting hurt. Eventually he'd be coming out of a turn, in the dark, checking the GPS, while shooting an approach back down to the field under a power line, and exactly when and where he needs to, he'd open the old 'money handle' and put the spray exactly where it has to go and then he'd know he had arrived and I'd be happy and so would some farmers."

Kenneth Trahan, a fifth-generation Louisiana rice farmer, put it this way: "Thank goodness there's a few pilots brave enough to do it. We can't grow rice without 'em." —



GREAT HERO YANG LING

**IN 2003, CHINA'S
FIRST ASTRONAUT
STEPPED OUT OF HIS
SPACE CAPSULE AND
INTO THE LIMELIGHT.
BY JAMES R. HANSEN**

AS SOON AS THE DIVINE VESSEL reached orbit over the Pacific Ocean, the Chinese people knew they had accomplished something remarkable. Inside the eight-ton Shenzhou V spacecraft, their 38-year-old countryman Yang Liwei, a lieutenant colonel in the People's Liberation Army, had entered the history books, joining the elite company of the Soviet Union's Yuri Gagarin and America's Alan Shepard as "first men" in space.

On October 15, 2003, the *yuhangyuan* or *taikonaut* (as some Western journalists had come to call a Chinese astronaut) spent a little more than 21 hours in space, orbiting Earth 14 times before his capsule reentered the atmosphere and parachuted onto the grassy steppe of central Inner Mongolia.

Pride in being Chinese was never higher. "Fifty years ago Chairman Mao declared, 'The Chinese people have stood up,' " one citizen remarked to a journalist in Tiananmen Square. "Now the Chinese people have left their feet and flown into space!"

The government had tried to keep its first astronaut anonymous, but a few days before the launch, Yang's identity was discovered and his picture published in a Hong Kong newspaper. Beijing then agreed to a live broadcast of his launch, but apparently lost its nerve at the last minute. It wasn't until 30 minutes after Shenzhou V achieved orbit that the government's flagship station cut into regular programming to make the proud announcement. Televised replays quickly followed, beginning a day of saturation coverage by the state-owned Chinese media. Yang's most reported remark, within China at least, was the one he made when shaking hands with Hu Jintao, his country's president, upon leaving for the launch pad: "I will not disappoint our Motherland. I will complete each movement with total concentration, and I will gain honor for the People's Liberation Army and for the Chinese nation."

Despite the bombast, what the Chinese people seem to have appreciated most during Yang's flight was his communication with his eight-year-old son, Ningkong. In a Confucian society—which China has remained, despite its communism—the father-son relationship is fundamental.

Although American astronauts rarely comment from space about their families, the Chinese press placed great emphasis on Yang talking lovingly to his "dear wife" and "dear son." After his return, a picture showing Yang and his wife Zhang Yumei embracing appeared in virtually every Chinese newspaper. The caption said she asked her husband what wonderful things he saw in space. "I saw our planet," he told her. "It's so beautiful, like you."

The story was an instant hit with the

a British colony to a "special administrative region" of the People's Republic of China with its own legal system, currency, and immigration laws wasn't going especially well. Morale in the city was low, its economy was weak, and officials of the new regime were so unpopular that the city had been hit by unprecedented anti-government protests. The city also suffered that year from an outbreak of severe acute respiratory syndrome (SARS), which had killed more than 100 people.

Several Hong Kong (and Taiwanese)



public. The *People's Daily* ran 100,000 extra copies, which were quickly snapped up. In some towns, parades and demonstrations broke out spontaneously. Schoolchildren drew pictures of spaceships and astronauts. Hundreds of wall posters appeared, many combining themes of 21st century technology with more traditional styles of socialist realism. Postage stamps were printed in Yang's honor. The *People's Liberation Army Daily* trumpeted: "For China this is the beginning and there will be no end."

Nor was it the end for Yang, who within a week of his landing went on tour. Accompanied by his son, he opened an exhibition of his Shenzhou V capsule, spacesuit, and parachute in Beijing, the first stop in a roadshow across China. Next up was Hong Kong, where Yang's visit, at the special invitation of the regional government, lasted six days.

In 2003, Hong Kong's conversion from

newspapers criticized the astronaut's visit as a thinly veiled attempt to boost pro-Beijing political parties in the region's upcoming elections. Correspondents reported that many Hong Kong residents were indifferent to Yang's feat. "It's nothing new—America did it years ago," a businessman said. "I won't feel anything just because of his visit," admitted a downtown shopkeeper. "It's just a gimmick," declared an accounting clerk. A 21-year-old female university student said, "I always liked Britain better."

Others were not so jaded. A survey by the Hong Kong Federation of Youth Groups found that after hearing the news about Shenzhou V, 71 percent of the city's young

Celebrations at the time of Yang Liwei's launch (above) and a warm reception in Hong Kong weeks later (opposite) suggest that the pride in his flight was genuine.

people felt prouder of being Chinese. Financial support for Yang's visit came from nearly 50 organizations in Hong Kong, not all of them pro-Beijing, and Yang's appearances attracted people of all ages. For the first time in the history of Hong Kong's Science Museum, an exhibit was kept open around the clock, for four straight days, to meet demand. When the astronaut arrived, several thousand people waving Chinese and Hong Kong flags lined the streets. "It's worth the wait," said a 73-year-old man. "I never thought I would live to see the day that China could proudly stand alongside the United States and Russia as nations that sent a man into space!" "I think they should make a cartoon strip of Yang," offered an 11-year-old boy. "I just want to shake hands with Uncle Yang," said another elementary school student.

As he was driven around Hong Kong Stadium in a golf cart, a capacity crowd of 40,000 gave Yang a standing ovation. Inside was a party of Hong Kong pop celebrities and movie stars, including Jackie Chan, whom Yang joined in a song. In a country where the concept of celebrity



STR/AFP/GETTY IMAGES

is still relatively new, only a few people aside from politicians—like pop singer Gao Feng, NBA basketball player Yao Ming, film star Zhang Ziyi, and Olympic diving star Guo Jinjing—are widely recognized. In Hong Kong Stadium, it was clear the country's first astronaut had the same mystique. "Uncle Yang looks more handsome in person than on the TV screen," said a primary school student who came to the stadium with her father. The *Chinese Language Daily* commented, "Yang is not just a star. The welcome he received

In a country still getting used to the notion of individual celebrity, the astronaut's traditional Chinese values – humility, duty, family – are what appealed to the public.

IT APPEARED TO BE JUST another fortified complex in the suburbs of Beijing, except that the white stone walls were immaculately clean. The chauffeur pulled our car to a stop at the gate, where two young soldiers stood at ramrod attention, wearing the green uniform of the People's Liberation Army. I was about to become the first American allowed inside China's astronaut training center, and the first U.S. astronaut to meet Yang Liwei, their Yuri Gagarin.

Because of my Chinese heritage, I had more than the usual interest in China's space program. As teenagers, my parents had both fled from China to Taiwan after World War II, in front of Mao's advancing communist army. During their university studies in Taiwan, my parents met and married. My older sister was born there.

I also hold the distinction of being the first astronaut of Chinese descent to walk in space and to command a space mission, two of the highlights of my 15 years with NASA. So when, through a web of contacts, I met Shangguan Chen, the director of the Astronaut

Research and Training Center

Inside Shenzhou Central

of China, last year, I jumped at his offer to visit the center.

Flying in to the Beijing airport last September, I noted that the air was extraordinarily clear. In all my previous visits to China, the sky had been dark with smog, the sign of a country running at full steam to industrialize. I took this as a good omen. Clearing customs, I walked through automatic glass doors and immediately found myself facing a huge Starbucks. I had to smile at how far China has come since my first visit in 1988.

As promised, a car arrived at eight sharp the next morning to take me to the center. The campus is quite new—it was completed only in 1998 – and seemed to me a newer, more modern version of Russia's Star City, where I've trained on several occasions. The center is self-contained, with living quarters for about 1,000 employees, including all dozen or so Chinese astronauts, as well as buildings for training, research, and even manufacturing. One surprise was that the street signs were printed in English as well as in Mandarin. Clearly, the leadership anticipates cooperating with the West.

At the training building, Chen and his deputies, along with Yang and Fei Junlong (the commander of China's second, two-

man space mission), greeted me warmly. I was flattered to hear that the entire Chinese astronaut corps was out on survival training, while the three of them had returned early to meet with me. I noted with amusement that Yang, Fei, and I were all dressed in dark suits and maroon ties. Do all astronauts of Chinese heritage think and dress alike?

We were ushered into a meeting room, where we had a chance to sit and converse in Mandarin. Yang thanked me for the congratulatory note and photo I had sent three years earlier after his Shenzhou flight. He and Fei seemed as thrilled as I was at our meeting, and complimented me on my own accomplishments in space, including three shuttle missions and a stay on the International Space Station.



NASA

NASA astronaut Leroy Chiao surprised his hosts by showing photos of the Chinese Launch Complex at Jiuquan (above) taken from orbit. Another photo showed the Great Wall, visible only through a camera.

My tour of the center began at the training simulator for the Shenzhou spacecraft. The simulator looks brand-new, and large backlit photographs from China's first two missions and survival training line the wall. I was allowed to look inside the simulator, although Chen declined to let me photograph the interior. The Shenzhou strikes me as a new and modernized version of the Russian Soyuz spacecraft, which carried me to the International Space Station in 2004. The Shenzhou is about 25 percent larger than the Soyuz and has a glass cockpit. Life support equipment is mounted around the periphery, and the launch/entry couches for the astronauts look remarkably similar to the Kazbek seats in the Soyuz. During my visit the simulator was configured for a crew of two (Fei's mission), but my understanding is that the next flight (which has slipped from this year to late 2008) will have a crew of three, and will include China's first spacewalk.

We then proceeded to a mockup of a space station that resembles a Soviet-era Salyut-class station. The Chinese had just finished a 62-day simulation inside the facility to evaluate closed-loop life support systems. It's no secret that China intends to build and operate a modern space station. In fact, Russian sources have told me that the docking mechanism of the Shenzhou was purchased from Russia. If true, this means that the Shenzhou could dock with the International Space Station.

After the morning tour, it was off to a private dining room, where a large round table was spread with a banquet setting. Over a delicious lunch of delicacies, including thousand-year-old eggs, jellyfish, and pig ears, we had the chance to talk in depth. Yang

Yang Liwei was polite but serious during his visit with Chiao (right) last September. The Chinese hero's high public profile may make officials in Beijing reluctant to let him risk his life on another space mission.

and Fei are both keen to return to space, although Yang spoke with less certainty on the subject than Fei. I suspect that since Yang is a national hero, the Chinese equivalent of Yuri Gagarin or John Glenn, the leadership may prefer to keep him safely on the ground.

As we ate we compared notes on adapting to space, on food, on photography from orbit. Yang is mostly serious and reserved; he rarely smiles. I asked him about his impressions of space. He replied that he was most impressed with the fact that from space, Earth shows no political borders. Fei, who is more animated and gregarious, talked of the home planet's beauty.

In the afternoon I gave a presentation about my space station mission, with lots of photographs from orbit. There was a gasp when I showed a detailed photo of the still-mostly-secret Chinese launch complex near

Jiuquan, in the Gobi desert. Fei commented that on his mission, the camera equipment was crude, and that he and crewmate Nie Haisheng were unable to shoot such detailed photos.

For the caper to my talk, I showed them a picture of the Great Wall of China that I took from orbit with an 180-millimeter lens. I had shot the first verified astronaut photograph of the wall. (Some Apollo astronauts claimed to have seen it with the naked eye, but I challenge anyone to discern which line is the wall, which is a riverbed, and which is a road or ridgeline.)

The end of the day had come rather quickly, and it was time to say goodbye. Chen presented me with several gifts, including a beautifully detailed model of the Shenzhou spacecraft, and Fei Junlong gave me a framed mission patch from his flight. Both are wonderful gifts that I will treasure.

LEROY CHIAO



COURTESY LEROY CHIAO

from Hong Kong residents exceeded that of any star. He is *the superstar*, supported by Hong Kong residents of different age groups and different walks of life."

What appealed most to ordinary people about Yang, however, was not pop glitziness but characteristics like self-control and diligence, which are more essentially Chinese. Born in Liaoning Province, a major industrial region near the North Korean border, his background was by no means humble or poor; his mother was a teacher and his father an economist. He joined the army at 18 and was recruited by one of the Chinese air force's top aviation colleges, where he earned the highest grade in every one of his classes.

As a pilot of attack aircraft, he had shown cool under pressure when, during a low-flying exercise over the barren Xinjiang region, his aircraft lost an engine. Yang radioed his situation, climbed to 5,000 feet—high enough to clear snow-covered Mt. Tien-shan—and landed safely at his base after his other engine flamed out. Emerging from the cockpit dripping with sweat, Yang was greeted by cheers from his colleagues and an on-the-spot promotion from his division commander.

In 1996, he and a dozen other pilots were chosen from a pool of 1,500 candidates for spaceflight training. During the first two years of a rigorous program, he reportedly never went to bed before midnight, and rarely left the training center. So dedicated was he to training that his wife once found him at home moving

rapidly in circles on a swivel chair—his own jury-rigged "centrifuge." In a critical series of final simulations leading to his selection for Shenzhou V, Yang identified and remedied all the problems his instructors had thrown at him. After each, when the instructor asked him whether he had made any errors, Yang confidently replied, "No errors at all." When a psychologist asked how he would feel if he were to fly a real spacecraft, Yang said, "I'll be more relaxed than talking to you, so let me go for the flight."

The combination of modesty and confidence struck a chord with the Chinese public. Newspaper article after newspaper article described Yang as "looking healthy and respectful and speaking in appropriate terms, with honest and cordial attitude." In return, the astronaut claimed to be "deeply moved" by the warmth of his reception from the "big Chinese family," and said at one event that the acclaim "made my heart beat faster than when I was in the spacecraft."

Leaving Hong Kong, Yang traveled to Macao, whose sovereignty had transferred from Portugal to Beijing in 1999. Macao's problems were different from Hong Kong's, having to do with wrenching economic transformations that had turned what was once a sleepy village with gambling dens into a tourist destination with huge modern casinos. Like Hong Kong, Macao was primarily concerned with national unification.

During his two-day visit, Yang visited

several of Macao's historic landmarks and spent an afternoon with 1,000 students and teachers, answering questions. The visit was profitable: As a result, an ad hoc consortium in Macao raised more than 14 million *patacas* (about \$1.75 million) for the China Space Foundation—an organization that promotes China's space industries (not to be confused with the China National Space Administration, the counterpart to America's NASA).

After Macao, "Great Hero Yang," as he was called in the press, visited the northern coastal metropolis Tianjin, which the World Health Organization had slapped with a travel advisory for its SARS outbreak just a few months earlier. Some of the most violent protests against locating SARS clinics in local communities had taken place in Tianjin, and Beijing may well have wanted the astronaut's visit to help raise the city's spirits.

But the impact of Yang's historic achievement ranged far beyond these few cities, selected by the government for political purposes. The Shenzhou flight triggered nothing less than a nationwide frenzy—what one Western observer called a "flow-



AFP/GETTY IMAGES



JIN/AFP/GETTY IMAGES

ering of patriotic kitsch." In Shanghai, an estimated half-million people queued in freezing weather to see China's first astronaut. At a high-profile rally in Beijing, Yang received the title "Space Hero." The General Political Department of the Chinese People's Liberation Army decreed him a "model" for Chinese soldiers and ordered all members of the PLA and the Chinese People's Armed Police to learn from Yang and his "heroic achievement." "Military activities in various forms should be conducted to study the spirit of the astronauts," the decree said.

One reaction to Yang's flight that the regime may not have anticipated was the immediate commercialization of his name. Everything from rice to milk to action figures quickly bore the astronaut's image, name, or title. The government tried to put a stop to this by trademarking and copyrighting the astronaut's name and likeness, but with only limited success. Naturally, Yang's home county in north-east China got into the act, selling "Great Hero Yang" lettuce and cabbage and naming a special white pear after him.

At one point, Beijing felt the need to

cut back on Yang's public appearances to temper the celebrity it had been so aggressively promoting. Commenting on the astronaut's public absence, Peng Zongchao, a professor of public policy at Qinghua University in Beijing, said, "The government should make sure there aren't excessive reports about one individual, because behind the success there was a whole project and system supporting the mission."

But "Great Hero Yang" again attracted attention when in the spring of 2004 he toured the United States. In New York, he met with Secretary-General of the United Nations Kofi Annan and presented two U.N. flags he had carried on Shenzhou V. In Washington, Yang visited Senator Bill Nelson of Florida, the only serving member of Congress to have flown in space, and Apollo 11 astronaut Buzz Aldrin. He toured Florida's Kennedy Space Center, met Mickey Mouse at Disney World, and got a VIP view of NASA's Johnson Space Center in Texas. Yang's U.S. tour was widely reported in the Chinese press and shown on Chinese television. A Web site run by the party newspaper, *People's Daily*, had a message reading "Yang Liwei's name will long be recalled, while nobody will talk about the politicians!"

In the past, individuals in China almost never enjoyed this kind of acclaim, except for leaders of the regime itself. China had lauded "national martyrs" such as Wang Wei,

the fighter pilot who died when his F-8 fighter collided with a U.S. Navy EP-3E aircraft in 2001, but when looking for people to serve as role models, the communist party usually picked plumbers and bus drivers for brief fame as "model workers."

Having watched the public adula-

tion with some dismay, Chinese officials followed a very different strategy with the two crew members of Shenzhou VI, who flew into space in October 2005. The government essentially hid the astronauts from view—there were a few celebratory events in Hong Kong and China, but no roadshow.

As for Yang, it's uncertain whether he will fly in space again. He has become an icon, lionized in the state-run press not only as the country's first man in space but as a star student, communist party member, devoted family man, and national treasure. Even his eight-year-old son became a celebrity, showing up over and over again in the Chinese media. On one occasion, party officials visited the boy's school and bestowed on his class the honorary title of "Space Squadron." Standing beside a model rocket, young



Marketability: Everything from rice to action figures soon bore Yang's name or image, despite the government's attempts to stamp it with a copyright. In the astronaut's home province of Liaoning, you could even buy "Great Hero Yang" lettuce. **Opposite: A trip to Disney World.**



GOH CHAI HIN/AFP/GETTY IMAGES

Ningkong gave a speech praising his father's accomplishment. "People asked me if I was afraid about Daddy going into space, and I said 'Not a bit,' because I knew that China's space technology was very advanced and Daddy was really awesome. I want to be like Daddy and travel to outer space someday."

With two Shenzhou flights accomplished and more to follow, it seems likely that other Chinese youth of Ningkong's generation will do exactly that—and perhaps someday reach the moon and Mars. Judging from the public reaction to Yang's flight, the Chinese people are excited by their prospects in space—and by the man who led the way. ➔

A DUST-COLORED DODGE DART station wagon races down a narrow road in the Mojave Desert, north of Los Angeles. Six feet above the windshield is a model airplane that looks as if it's flying backward. Inside the car, the driver maintains speed by reference to a primitive air pressure meter suction-cupped to the windshield; another man, his bushy sideburns fluttering in the hot breeze, flies the airplane with a radio-control modeler's control box and notes the voltages from crude force gauges aboard the model.

It's 1975. The man in the right seat is Burt Rutan, the model airplane is the VariEze, and the rig on the roof is his "car-top wind tunnel." In the years to come, the VariEze will revolutionize airplane homebuilding and Rutan will become the *enfant terrible* of a generation of aeronautical engineers, masterminding

ing the 1920s—all came from wind tunnel testing of models and full-scale airplanes.

Gerald Landry, who managed the California Institute of Technology's famous GALCIT tunnel—Guggenheim Aeronautical Laboratories, California Institute of Technology—until its demolition in 1997, recalls the interactive approach to tunnel testing used by manufacturers like Northrop, Lockheed, and Douglas, which would contract with Caltech for tunnel time. "They would send a whole team, not just aerodynamics guys but the engineering and model shop guys too," Landry says. "We'd run a test, and if there was a bad area somewhere, the shop guys would take material away or build it up and we'd run it again. I have my thumbprint in a number of airplanes' wing root fairings."

This was the procedure when the wing root and landing gear fairings of the six-passenger Northrop Alpha, an early TWA airliner and GALCIT's first customer, were developed by trial and error in 1931. The Alpha was a triumph of empirical aerodynamics; the drag of the wing-fuselage combination was eventually reduced by half. The original wind tunnel model still exists; it is on display at the Western Museum of Flight in Torrance, California. But it is the exception. Countless of these statues of airplanes-to-be, although prized by collectors as works of art, were discarded or destroyed once they had yielded the necessary information.

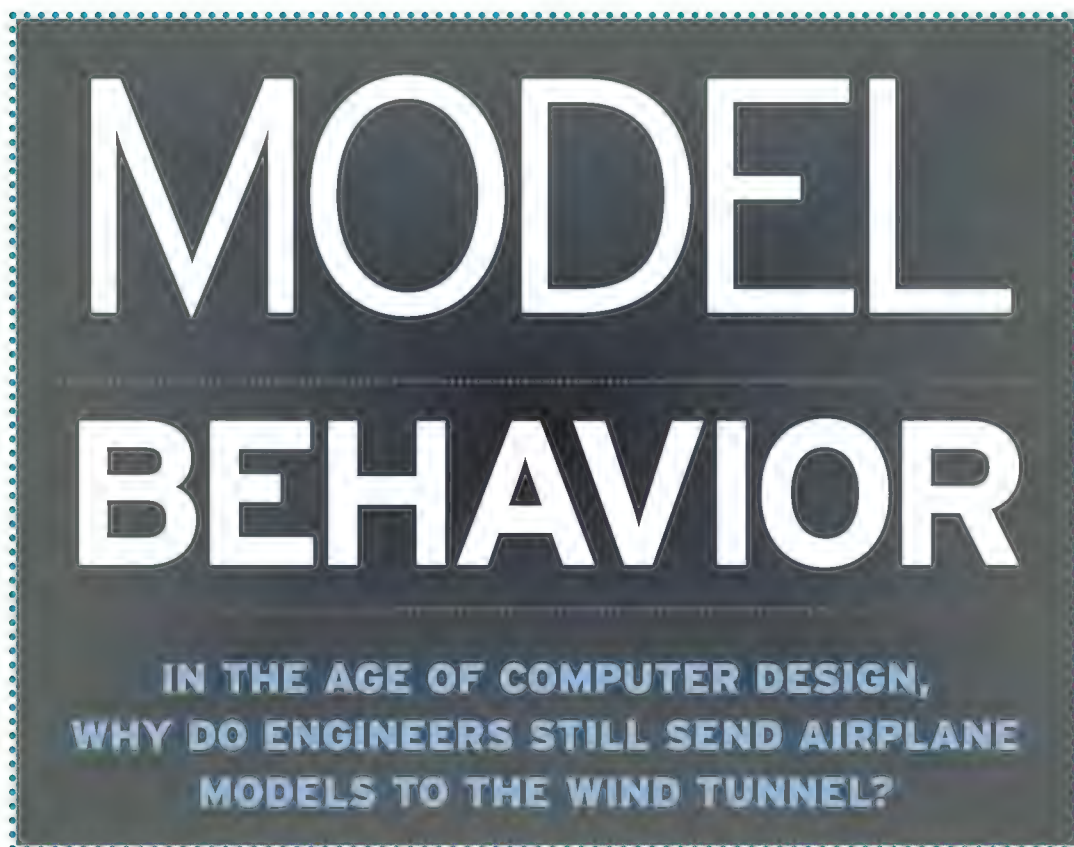
Vast quantities of information emerged from decades of wind tunnels tests, filling libraries with reports on everything from the behavior of overall aircraft configurations to the tiniest details of structure or shape. The information found its way into multi-volume compilations of mathematical methods to predict the performance and behavior of new designs. But these methods were like systems to predict weather based

on general observations of past trends, *by Peter Garrison*

rather than on precisely extrapolating from present conditions in light of the basic laws of heat and fluid motion. As with weather forecasting, aerodynamics confronted a problem of sheer scale: The underlying physical laws had been known for a long time, but applying them to practical problems involved staggering numbers of calculations.

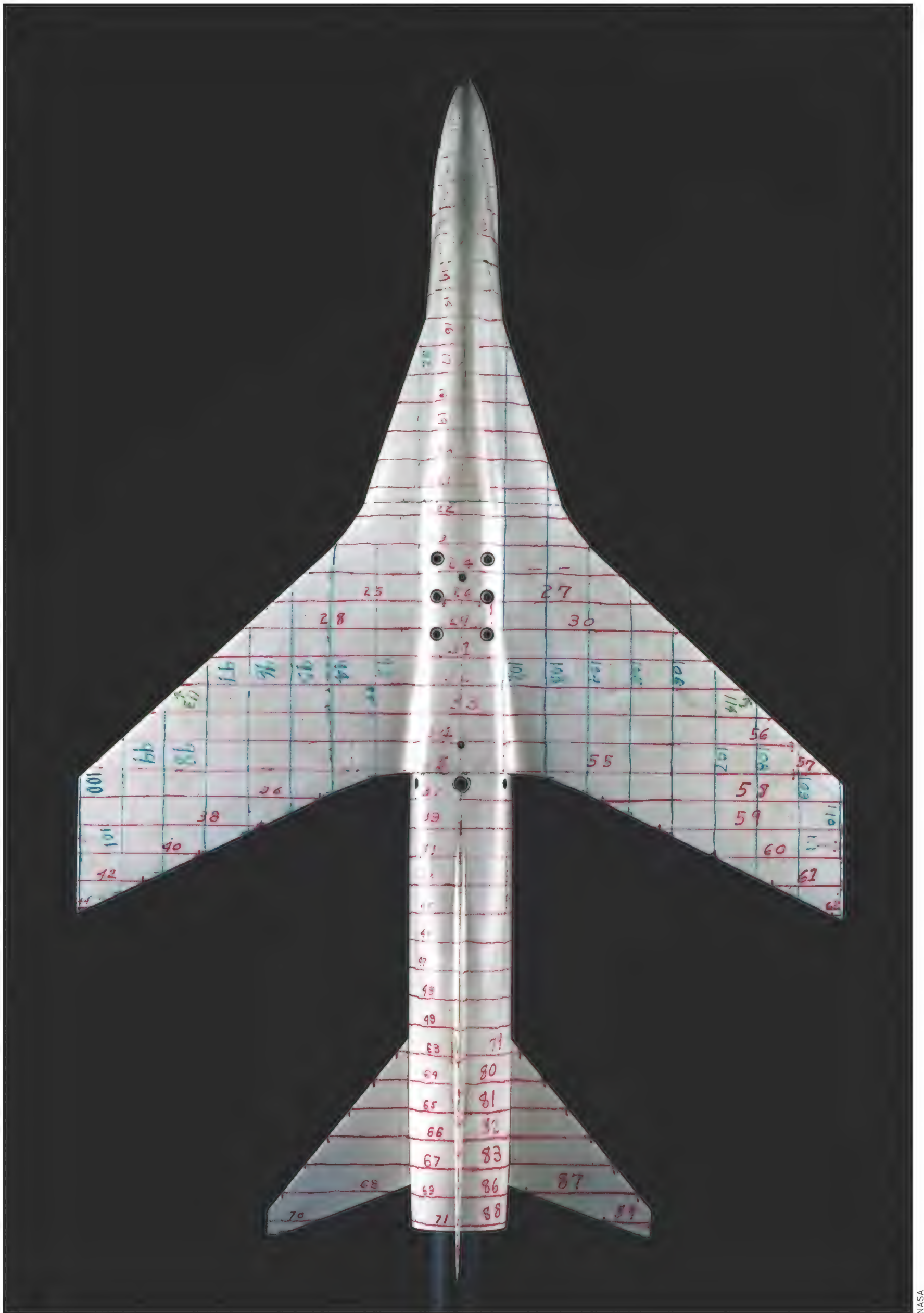
The advent of the fast digital computer made it possible to perform these calculations in a reasonable amount of time. Since the 1970s, computational fluid dynamics or CFD—the solution of aerodynamic problems by

Before supercomputers, wind tunnels quantified performance. Reference measurements on this model are used to determine the cross-sectional area for tests of a modified F-8's supercritical wing.



the first private manned flight into space.

Rutan tested that model, and others since then, to validate the novel configurations that are his trademark. Immersing physical models in genuine wind has always been the most direct way to collect aerodynamic information and verify new insights. German aviation pioneer Otto Lilienthal and the Wright brothers conducted hundreds of model tests. Even the great engineer Gustave Eiffel, of Eiffel Tower fame, built large wind tunnels to test wings and whole airplanes well before the start of World War I. Only by viewing and measuring the behavior of scale models in wind tunnels, and by using various tricks to reveal precisely what the air was doing, could aerodynamicists find their way to the best designs. The thick airfoils that made cantilever wings possible, the National Advisory Committee for Aeronautics cowlings that reduced the drag of radial engines, the fillets and fairings that doubled cruising speeds dur-



Models have become highly prized for their historic and aesthetic value. Collector Paul Kidder owns both a model of the Boeing X-20 Dyna-Soar (above), designed to fight the cold war at 10,000 mph and 350,000 feet, where it could down Soviet satellites, and a 1940s wooden model of a Pratt-Read LNE-1 training glider.

numerical simulation—has increasingly challenged the wind tunnel for the role of the airplane or missile designer's most valued tool. Just as the proliferation of office computers inspired predictions of the disappearance of paper, the advent of CFD was claimed to herald the demise of wind tunnels. Both forecasts were premature. Wind tunnel testing still thrives, in part because it provides the indispensable final validation of computed results, and in part because for many kinds of tests it is actually cheaper and faster to build a physical model and test it than it is to prepare a complex and detailed computer model and then analyze it repeatedly over a wide range of flight conditions.

CFD has been, in a way, a perennial victim of its own successes. It is now called upon to solve problems that would have been considered impossible a decade ago. But the persistent obstacle for computer aerodynamics, according to Caltech aerodynamicist Mory Gharib, is the difference in size between the largest and the smallest objects it must deal with.

"Ideally, you would like to be able to analyze the smallest eddies in the flow, the so-called Kolmogorov eddies," he explains. "But they're very tiny. To examine the flow field surrounding a full-scale transport on this scale, you'd be calculating for years. So you have to be satisfied with looking at larger chunks, and that leaves you with some uncertainty. That's where the wind tunnel comes in. It anchors your computational results."

Cost, however, is a persistent issue. Engineers at Honda, enjoying an ample budget for development of a light jet, relied on a continual alternation of computational and wind tunnel results, obtained with a number of different models and in several different tunnels. They arrived at a design that is unconventional—the engines are mounted on pylons that sprout from the upper surface of the wing and the nose bulges strangely—but is claimed to be more efficient than the usual arrangement, in which the engines are attached alongside the rear



CHAD SLATTERY (2)

fuselage. Sino Swearingen Aircraft Corporation, on the other hand, with a tighter budget for developing its own small twin-jet, bypassed wind tunnel testing of the wing, only to lose a prototype and its pilot in flight testing when an unanticipated transonic shock wave made the airplane uncontrollable in roll. Belated wind tunnel testing revealed the problem and provided the fix.

The uncertainty inherent in CFD has given rise to a derisive nickname in the wind tunnel world: Can't F—in' Decide. In reality, however, CFD and wind tunnel testing work synergistically. Designs are first developed and refined computationally, then tested in a wind tunnel to verify the results. Anomalies identified in the wind tunnel are studied with CFD, which is able to resolve fluid behavior more precisely and clearly than tunnel testing can. The wind tunnel tells you that the drag is high; the computer shows you why. The cycle may be repeated many times before the final design crystallizes. But the imponderable element of customer confidence always favors the empirical result. "No one," says Chris Athaide of Tri-Models, a southern California wind tunnel model fabricator, "will buy an airplane

that hasn't been in a wind tunnel." John Roncz, a freelance analyst who has contributed to many of Rutan's designs, makes a similar observation, but from a more cynical—and CFD-oriented—point of view: "The purpose of a wind tunnel test is to convince management to proceed with the program."

Many models have moving parts, like landing flaps or control surfaces articulated on tiny, geometrically accurate hinges. The quality and precision of their surfaces and joints are breathtaking. But not all models are the beautiful "high fidelity" objects made by the specialty shops. A Revell kit may serve just as well. And although photographs often show models in tunnels being groomed by technicians in white lab coats, real wind tunnels are sloppy places where jeans-clad workers tend scuffed models patched with Bondo and sweep up chips and filing debris between tests. Much wind tunnel work today involves

Don't Try This at Home

WIND TUNNEL MODELS must be very strong, with a much larger factor of safety – four or five – than the 1.5 used for actual aircraft (meaning the aircraft can survive loads 1.5 times greater than what it is expected to encounter). For a model to break apart in a wind tunnel would be disastrous, because flying debris would almost certainly damage the big fans located downstream. Most high-speed models today are therefore machined from solid aluminum or stainless steel, a slow and costly process. They are mounted in the tunnel on balances that measure "forces and moments" – that is, both direct and rotational forces in all three axes. These balances are highly specialized instruments, massive because they must support models sometimes weighing thousands of pounds and subjected to aerodynamic forces of thousands of pounds as well. At the same time, the balances have to be able to make delicate measurements with great precision and repeatability. The target tolerances for wind tunnels are around 0.1 or 0.2 percent, but each tunnel has special characteristics and abilities that are known throughout the close-knit testing community. Tunnels used for subsonic aircraft typically run at 200 mph or less; transonic tunnels specialize in the flight regime from 500 mph up through Mach 1.2. Between 200 and 500 mph, there is little to be learned. But a vast frontier opens in supersonic and hypersonic "blowdown" tunnels, in which air is first pumped into or sucked out of huge tanks, then vented through the tunnel. That produces half a minute of roaring flow at several times the speed of sound. It makes the earth shake, and subjects tiny steel models to enormous loads.



CHAD SLATTERY

reducing the drag on trucks, automobiles, railroad cars, and even sports gear like golf balls. At NASA's Ames Research Center in California, a team led by Rabi Mehta has used relatively crude models of trucks and coal cars to find ways of reducing their fuel consumption. At the University of Washington, Scott Eberhardt studied the flight characteristics of World War I fighters using free-flight models bought at a hobby shop. The type of information being sought determines the quality of the model needed.

The basic results of most wind tunnel tests are "forces and moments"—the loads placed on the model by moving air. But investigators are interested in much more. To facilitate stress analysis and structural design, engineers drill minute holes, sometimes numbering in the thousands, in the skin of a model and connect them to pressure sensors. Another way to measure pressure involves a chameleon-like paint that changes color under pressure. To observe the

Tri-Models technician Skip Maughan installs a flap bracket on a 7.3-percent-scale wind tunnel model of a Cessna Citation CJ4 business jet.



The leading edge of a wing on a Tri-Models low-temperature wind tunnel model for a civil transport (above) has tiny punctures that allow measurement of pressure. Right: In the mid-1950s, the need for speed inspired Douglas Aircraft to design the Model 1355 supersonic long-range interceptor, a design that did not get much beyond this wind tunnel model.

paths taken by the air as it races past the model, tufts—which may be fluorescent filaments or just snippets of ordinary knitting yarn—are attached to the model like hair plugs. Alternatively, the model can be painted with a mixture of kerosene and a fine powder like talc or the china clay used for ceramics; the kerosene evaporates in the tunnel, leaving behind the tracks of the airflow like silt deposited by a flood. Slender streams of smoke help visualize flow paths, or, in some tests, the model is immersed in slowly flowing water and enmeshed in fine strands of fluorescent dye that glow under ultraviolet light like so many tropical fish (Boeing studied the landing flaps of the 747 this way). Special aeroelastic models, built to imitate the flexibility and mass distribution of the full-scale airplane, test susceptibility to destructive flutter. Even noise comes in for wind tunnel testing: A large model of the Boeing 777 was tested at Ames with highly directional microphones to locate the sources of aerodynamic noise; one major culprit turned out to be the tips of the landing flaps.

Though most wind tunnel models are eventually discarded, those of airplanes still in production or certain types of use are kept in storage, to be dusted off and re-tested when modifications are contemplated or problems arise in service. One of those is Ames' three-percent model of the space shuttle. After the 2003 *Columbia* disaster heightened concern about the trajectories of falling foam and ice, the highly detailed model was re-tested to assess the effects of replacing a large slab of foam that covered wiring and hydraulic lines on the external propellant tank with small met-

al shields. Ames first subjected the changes to computational investigation, using its supercomputer, then tested them in the wind tunnel to confirm the results. The agreement, remarkably, was good, though the task—involving tumbling irregular shapes with turbulent and separated flows, and large differences in scale for different components—was, from a computational standpoint, extremely difficult. "This was a big win for CFD," boasts NASA's Stuart Rogers, an aerodynamicist and award-winning developer of computational aerodynamics software, who directed the



analysis. "We've come a long way."

It's ironic that at the same time numerical analysis challenges the primacy of the wind tunnel for aerodynamics research, the creation of wind tunnel models is becoming increasingly digital. The same computer-aided, design-generated digital definition of the airplane's shape serves as a basis for both CFD and wind tunnel models. Specialist shops like Tri-Models—there are four or five independent ones in the United States, in addition to those operated by airframe manufacturers—employ numerically controlled milling machines that shave away at aluminum or stainless steel billets within closed cabinets while minders twiddle their thumbs. Completed models are then mounted on a measuring table and their contours checked at thousands of points with an electronic indicator. The hum of ventilation fans is interrupted only by faint bleeps of electronic satisfaction as the coordinates of each point are tucked away in a computer file.

At Ames, Kurtis Long, an irrepressibly good-natured specialist in the aerodynamics of surface ships, adjusts the alignment of a yard-long ship model in a wind tunnel test section. The purpose of the test is to map air disturbances in the wake of ships' superstructures, because helicopters landing on their

aft decks may fly through them.

Long's model ship—delicately detailed, down to each railing, antenna, and hatch—came into being in Valencia, California. Valencia's industrial parks contain several firms engaged in the futuristic business of stereolithography (SL), a way to manufacture single examples of complex objects by a completely robotic photochemical process.

SL creates solid objects of extreme complexity by selectively hardening an epoxy-like liquid with laser light. The process begins with a computer file, a cloud of numbers defining the shape of an object as a series of cross-sections at intervals of a few thousandths of an inch. Inside the SL machine, a simple metal cabinet with an angled window—think of it as a three-dimensional printer—an ultraviolet laser dances across the surface of several gallons of liquid photopolymer, a clear plastic liquid that hardens when the laser contacts it. A perforated floor immersed in the polymer drops by a few thousandths of an inch and the tremulous blue-violet light, directed by the computer file, sketches anew. Over and over and over—there is no sound, no one watches, no waste results. When the process, which advances at a rate of inches per hour, is finished, the perforated floor rises to the surface and the newborn object—a gear, a turbine, a wing, a ship, anything you like—emerges from the liquid like Aphrodite: perfect, virginal, and untouched by human hands.

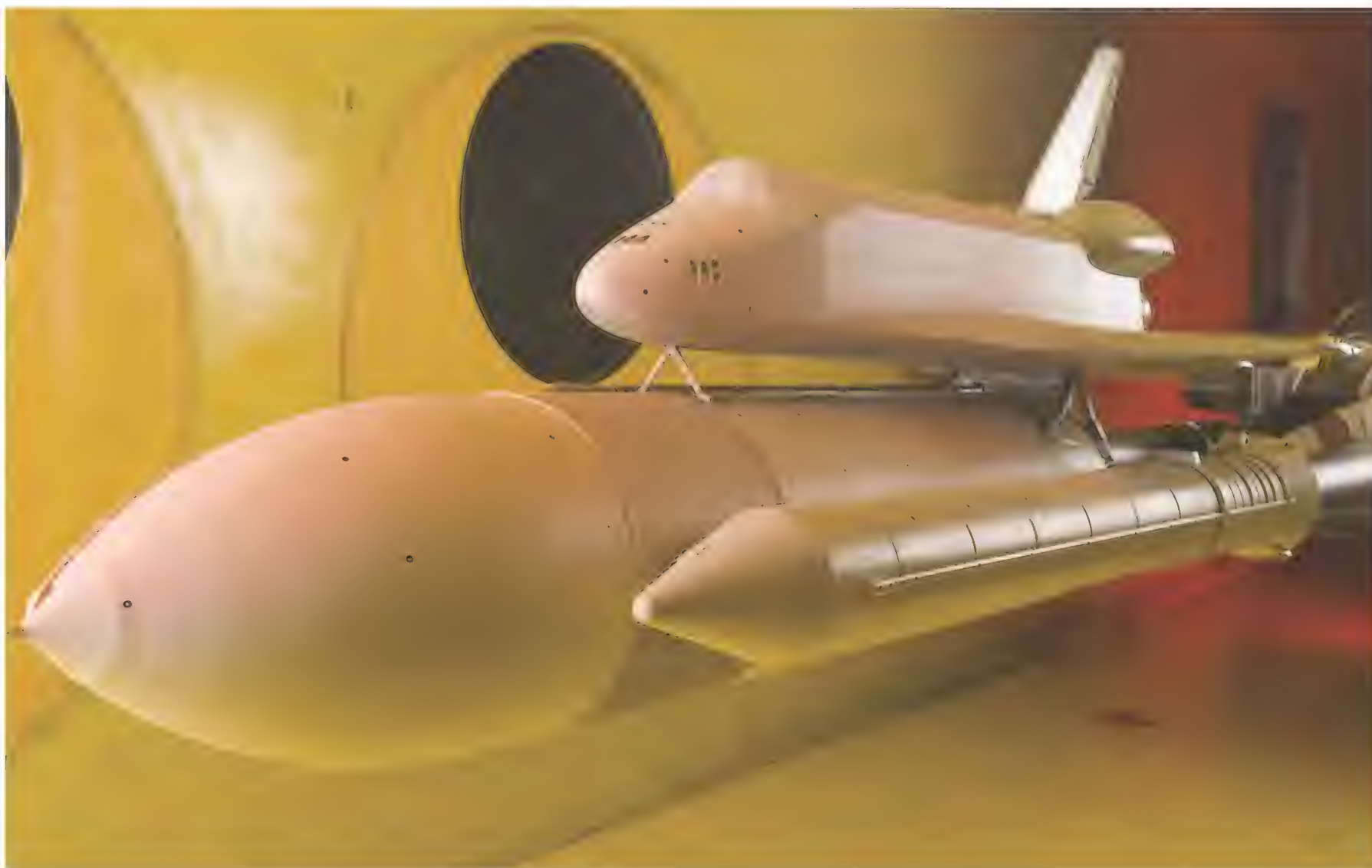
Stereolithography and numerically controlled

machining represent the final stage in the withdrawal of the human touch from the making of wind tunnel models. The craftsmen who carved mahogany for Douglas and Northrop and Lockheed are mostly gone; likewise the sheet metal men who built up countless impeccable wing sections for NACA, and the artisans whose files and sanders sculpted massive steel to the precision of a clockwork. Their skill was impressive, and no doubt their satisfaction was great. But technology moves forward, toward pilotless airplanes built by pilotless machines, and the art and science of wind tunnel testing moves with it. ➤

After the design proved its worth in the wind tunnel, North American built some 200 T2J-1 jet trainers (above). A scale model of the space shuttle stack wears pink paint that enables measurement of surface pressures.



CHAD SLATTERY



NASA AMES

Resto

“That Big Biplane” | 1929 Zenith Z6A

WE’VE ALL HEARD of airplane restoration projects that drag on until people begin to suspect the restorer doesn’t really want to finish; he’s happy just to be tinkering. This isn’t one of those projects. It did drag on—for 17 years—but knowing Glenn Peck and the late John Mullen, the two men responsible for it, I never doubted that one day the airplane would fly.

In 1986, Mullen, an electrical engineer from St. Louis, bought a rare and battered biplane at an auction in Boise, Idaho, and trucked it home to Creve Coeur, a small Missouri airport with a paved runway and a grass landing strip that he owned with two partners (see “The People and Planes of Creve Coeur,” June/July 2003). Creve Coeur was already home to dozens of antique aircraft and today has a large collection of Wacos, Stearmans, Staggerwings, rare or one-of-a-kind types, and one particularly stunning Fairchild 24 (mine). But compared with the others, Mullen’s Zenith biplane was a monster. It weighed almost 4,400 pounds with a full tank and full complement of pilot and cargo, and it had a 41-foot wingspan

and an enormous cabin in front of the pilot. Around the airport, most people referred to it as “that big biplane of John’s.” We think seven were built, and only Mullen’s survived—barely.

The airplane Mullen brought to Creve Coeur was a daunting project: It had wings, a fuselage, and a whole bunch of parts. With scant records from the manufacturer, nine old black-and-white photos, and a 30-second film clip, he gradually pieced together the airplane’s history and decided what the restoration should make it look like.

The Zenith Aircraft Corporation built the airplane in 1929 at the request of A.A. Bennett, a transport pilot who needed a sizable craft to get men and materials up to the mines in Idaho and Alaska. Zenith had been manufacturing farm implements in Midway City, California, until Charles Lindbergh’s 1927 Atlantic crossing convinced its owners—as it did many entrepreneurs around the country—that there might be something to this airplane thing. The company’s first airplane was a tri-motor the builders called the Z-12

Albatross. It barely got airborne. They tried again with the Zenith Z6A before the Depression took its toll and they went back to farm equipment.

Bennett bought the third and fourth Z6s, which he used to haul everything—sheet metal, saws, pianos, cows—to the Idaho miners. In 1946, Bennett sold the Zenith to the Blue Moon Sky Ranch in Boise, Idaho, where it was put to work flying supplies. It passed through a handful of owners before ending up with a cropduster named Pete Fountain. He flew the airplane until 1964, when operating expenses forced him to park it alongside the runway in Boise, where it stayed until the auction in 1986.

Mullen took the airplane apart, cut the fiberglass hopper (for insecticide) out of the fuselage, and built the fuselage back up. He cleaned up the landing gear and had a new tail wheel assembly and gas tank built. And that’s about as far as the restoration got when the 1993 Missouri River flood shut down the airport and halted the effort. Mullen, focused on lining up financing for repairs to the airport, turned to Glenn Peck.

Peck is the director of maintenance for

One of the Zenith’s most distinctive features is the large cabin in front of the pilot, which holds a table and four seats. Below: Glenn Peck, master craftsman, stitches fabric to the wing ribs.



ration

the Historic Aircraft Restoration Museum at Creve Coeur and one of the finest craftsmen I've ever known. I've seen him transform a half-dozen airplanes—including a 1928 Curtiss Robin that in 2001 was recognized in a restored classic category at the Experimental Aircraft Association's Oshkosh, Wisconsin fly-in. In his 25-year career, he's restored 30 tube-and-fabric aircraft. He started work on the Zenith in 1996, and, because it had been outside for three years, took the airplane back to the point where no two pieces were connected. For eight years, he worked in his free time on weekends and in the evenings, whenever he had the chance, putting the pieces back together.

By spring 2004, Peck had made enough progress on the airplane that he and Mullen thought he could finish it in time to show it at Oshkosh that July. Peck hurried to overhaul old instruments and install modern ones, like a moving-map GPS receiver. He installed brakes from a

some pitting. When I showed it to Glenn, he realized that what had appeared to be stainless steel wires were actually chrome-plated plain steel. With those pitted wires, we couldn't fly. Peck placed a rush order with Bruntons in Scotland, the sole manufacturer of flying wires. The new wires arrived on July 10, two weeks before the fly-in.

The engine runs took several days to finish: The primer was too small and not putting enough fuel in the engine. After this was fixed, Peck taxied the airplane twice before calling the Federal Aviation Administration's designated airworthiness representative, who certified the Zenith to do what it hadn't done in 40 years—fly.

Frequently restorers will need a deadline like Oshkosh to make the final push to finish a project. At Creve Coeur, we



COURTESY OF THE ESTATE OF JOHN MULLEN

After its brief fling with aviation, Zenith Aircraft Corporation returned to making farm machinery.

were thankful for the extra pressure because it gave John Mullen the chance to taxi his airplane. A few days later, John died. Today, Mullen's son Shaun owns the aircraft and is looking for a buyer.

Whoever buys the Zenith will have the third of the series and sole survivor, but another exists. Zenith Number 5 flew in Alaska for several years until its crew landed it on a frozen lake and walked to a shoreline restaurant. While they were eating, they heard a cracking sound and came out just in time to see Number 5 sink in 600-foot-deep Lake Cordova, where the airplane remains to this day.

STORY AND PHOTOGRAPHS BY DON PARSONS

The Pratt & Whitney Wasp first flew in 1926, three years before the Zenith. Below: John Mullen was a very proud owner of a one-of-a-kind biplane.



Vultee BT-13, a heavy World War II Navy trainer, but found that even these were marginal when trying to hold the airplane during the run-up of the 550-horsepower Pratt & Whitney R-1340 engine (from a Curtiss SOC Navy Scout).

With the deadline drawing near, I pitched in now and then. One day I was cleaning the flying wires in preparation for attaching the wings when I noticed



AND THEN THERE WAS ONE

**TEN AIRPLANES THAT ARE
THE LAST STILL FLYING.
BY STEPHEN JOINER**



THE SLOGAN “KEEP ‘EM FLYING” FIRST appeared on War Production Board posters to inspire aircraft factory workers during World War II. To the delight of today’s aviation fans, dozens of organizations have been formed with mission statements that include that very sentiment. Individual pilots have also taken up the cause, and although vintage aircraft owners don’t restore and fly their airplanes at airshows out of altruism alone, many of them describe a sense of stewardship. Aviation, as a pastime, seems to inspire a commitment to preservation.

We have profiled 10 aircraft whose owners have devoted the time, effort, and money to keep them flying. Our definition of “flying” requires that each aircraft be certified airworthy by the Federal Aviation Administration in the United States or the Civil Aviation Authority in the United Kingdom, and the aircraft has to have some record of recent flight and the potential for future flight. The eclectic group of aircraft that follows is by no means comprehensive, and we invite readers to notify us of other aircraft that should be included.

—The Editors

Northrop Flying Wing

Northrop Aircraft built four one-third-scale N-9M flying wing prototypes in the early 1940s to prove the feasibility of its B-35 bomber. When that program was axed, the remaining prototypes were ordered destroyed. Planes of Fame Museum founder Ed Maloney liberated the last one by trucking it out of California’s Edwards Air Force Base as scrap. After the little yellow airplane spent 30 years in storage, vintage aircraft restorer Ron Hackworth led a 13-year reconstruction. Working Saturdays in a succession of warehouses and hangars around southern California, volunteers rebuilt the mostly wood aircraft. In 1994, N-9MB took flight with former Planes of Fame president Don Lykins at the controls. “We had the benefit of advice from some of the original pilots,” says Hackworth of those early flights, “so there were no surprises.” Today, Hackworth regularly pilots N-9MB for Planes of Fame in Chino, California. “I’ve never flown it anywhere where the reaction was anything less than complete amazement,” he says.

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Grumman F4F Wildcat

They found it with one tire inflated, cockpit and flight controls intact, and a battery that could still hold a charge. By the standards of salvaged warbirds, the Wildcat was almost pristine, especially since it had spent 47 years on the bottom of Lake Michigan after a U.S. Navy training accident in 1944. Embalmed by the low oxygen level of the frigid lake water, “it looked like it had come back through a time warp,” says owner/pilot Steve Craig. Grumman produced nearly 2,000 of the rugged fighters, but stout hardware is not the Wildcat’s only legacy. “It’s the heroism demonstrated by Navy and Marine pilots who flew F4Fs during the first two years of the war,” says Craig. The only F4F now flying, NX12660 just does it: Last summer’s airshow itinerary reads like a NASCAR tour. “People appreciate what it represents,” says Craig. “It’s literally a memorial.”



DOUG FISHER



JIM KOEPNICK

Boeing 247

All-metal, low-wing, and streamlined, the 247 was the world's first modern airliner. The 10-passenger 247, with reclining seats, soundproofed cabin, and a 20-hour coast-to-coast timetable, launched air travel's golden era in 1933. Three decades later, NC13347 languished at a cropdusting airstrip in Taft, California, ingloriously deteriorating from insecticide exposure. In 1980 Seattle's Museum of Flight began a 14-year restoration. "We tore it apart and rebuilt it from the ground up," says Frank Leathley, a former Boeing engineer and a volunteer on the Boeing-supported project (see "One Good Year," Feb./Mar. 1997). Featuring vintage United Airlines "Mainliner" colors and a 1939 interior ("More legroom than you get today," says Leathley), the last 247 is flown by another volunteer, Boeing 787 chief project pilot Mike Carriker. "It's an appreciation of what it was once like to really fly," he says of the low, slow experience. When Carriker test-flies the 787 this year, he'll be captain of Boeing's newest and oldest airliners.

Sikorsky S-43

Known on Pan Am's island-hopping routes as "Baby Clippers," only two were privately owned: Harold Vanderbilt's opulent air yacht, and the stripped-down, flush-riveted N440, which was delivered to Howard Hughes in 1937. N440 was Hughes' pet plane; he used it to practice water landings in Nevada's Lake Mead and to give unlogged flight training to Hollywood starlets. He kept it ready 24/7 in a guarded hangar in Houston until he died. The late Ron Van Kregten, an aircraft collector, acquired the S-43 in 1977, and veteran pilot Jesse Bootenhoff began providing rare glimpses at fly-ins. The mystique of Hughes' amphibian captivated even seen-it-all Oshkosh crowds. "They were lining up so fast to get in, I couldn't get out," says Bootenhoff. Baby Clippers star in Art Deco travel posters, but the only one still flying maintains a low profile at Brazoria County Airport in Texas. "Most people have no idea one still exists," says Bootenhoff.





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Cinema II Glider

For idle youth during the Great Depression, a 20:1 glide ratio was a positive economic indicator. Works Progress Administration vocational classes distributed kit versions of the Frankfort Sailplane Company's popular Cinema glider to unemployed teenagers across the country. After assembly, students got a paycheck—and flight time with an instructor. Only Dean Kramer's two-seat Cinema (made during the WPA era) still flies. NC24185 was grounded for 40 years before a revamp; it's now "as original and authentic as we can get it," says Kramer. When it came time to paint the glider, he followed the original color scheme of burgundy and silver. "It draws a good deal of attention in a lineup of basic-white modern gliders," he notes. Though his restoration of the sole surviving Cinema has earned international recognition, Kramer considers himself a temporary caretaker: "For me, bringing it back to life for the next generation is what it's about."



GILLES AULIARD



Vertol H-21

"That thing saved my life," Vietnam veterans occasionally tell Mark DiCiero. The first chopper in the helicopter war, CH-21B assault helicopters were sent to Vietnam as early as December 1961. Its stretched, bent fuselage inspired the nickname "Flying Banana." Bell UH-1 "Hueys" soon replaced Flying Bananas in the assault role, but H-21s continued to fly troop transport and medical evacuation missions. "It pulled a lot of people out of bad situations," says DiCiero. N64606 had already been written off by one major museum when DiCiero found it in 1989 in Chino, California. "They pretty much assured us there was no way we would ever get it flying, nor keep it flying," recalls DiCiero. Ten thousand restoration hours later, it became the first of a vintage fleet at Classic Rotors Museum in Ramona, California—and is still the last Banana flying.



TYSON RININGER



GEOFFREY LEE



F-86A Sabre

"The first of the first," Cliff Spink, who flies the last one, calls it. America's founding fighter jet, the 1948 A-series Sabre, debuted the swept wing, set a world speed record, then broke the grip of MiG air superiority in the Korean War. Later, more refined variants would feature fully power-assisted controls and a more advanced tail de-

sign, but the 554 A-model aircraft occupy a distinct niche: Jet-propelled combat was never so no-frills or hands-on again. Only no. 178, now designated G-SABR, still flies. Restored by former P-51 Mustang pilot Ben Hall in 1971, it was acquired by Golden Apple Trust in the United Kingdom in 1990. "You instantly sense that

the airplane is a thoroughbred," says Spink. G-SABR is a Yankee star at European airshows, and Spink, a retired RAF air marshal, wants its airworthiness to endure for posterity. "It's not ours," he says. "None of these aircraft are. They belong to the future."



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Boeing B-29 Superfortress

The enormous wings of N529B were shading a China Lake, California boneyard when Commemorative Air Force member Victor Agather learned of the bomber's existence in 1971. Agather had been looking for a B-29 to restore, and he was thrilled when fellow CAF member and commercial pilot Roger Baker spotted the B-29 during an overflight. Agather financed a four-year CAF restoration of the aircraft, and the restoration team christened the bomber *Fifi* after his wife. To underwrite its 400-gallon-per-hour fuel appetite, he proposed an unorthodox solution: public tours. "Nobody was doing that in 1975," says Agather's son Neils. The only Superfortress flying has paid its way ever since by thrilling thousands at airshows around the country. "People come and say, 'My grandfather flew one in the war. Can I sit where he sat?'" says Neils. After 30 summers, the four 2,200-horsepower engines are marginal, and continued airworthiness depends on a CAF fundraising drive for new powerplants. Fortunately, Texas industrialist Joe Jamison has stepped forward with \$2 million, and Neils is confident more of *Fifi's* fans will pitch in: "Anyone will tell you, she's the queen of the fleet."



▼ **Gloster Gauntlet**

When skeptics ask if the 70-year-old biplane is really airworthy, Jyrki Laukkanen replies, "It was this morning when I flew it here." Last of the open-cockpit British fighters, Gloster Gauntlets entered service with the Royal Air Force in 1936. After the Soviet Union invaded Finland in 1939, 25 Gauntlets were shipped through

Sweden to bolster Finnish defenses. In 1976, members of the Finnish Air Force Technical Guild followed rumors of an abandoned warbird to a farm in Juupajoki, a municipality in western Finland. They found a Gauntlet in pieces—"hardly identifiable as an airplane," says Laukkanen. After an 11,000-man-hour restoration, OH-XGT, painted in the wartime markings of the Finnish air force (including swastika-like symbols, which at the time signified good luck in Finnish culture), became a photo-op favorite on the Finnish airshow circuit. Retired FAF fighter pilot Laukkanen has flown the somewhat finicky Gauntlet every summer for 20 years. "Flying it requires continuous attention," says Laukkanen, who has 1,300 hours in MiG-21s. "It keeps an old test pilot in sharp condition."



MIKKO MALINIEMI

▼ **Percival Mew Gull**

Tony Smith speaks of the Real Aeroplane Company's tiny, cream-colored monoplane as legend. "It's the Holy Grail of British air racing," says Smith, RAC's chief pilot and the only one entrusted to fly the racer. The Percival Aircraft Corporation produced a half-dozen Mew Gulls in its Gravesend, England factory in 1934, and the aircraft went on to dominate the field. The first civilian aircraft to exceed 200 mph, G-AEXF captured the King's Cup in 1938. Mew Gulls were prone to mishap, and only G-AEXF defied the actuarial tables by undergoing numerous rebuilds. The Real Aeroplane Company keeps the Mew Gull with the rest of its collection at Brighton Aerodrome in northern England. "The perfect harmony of the controls is just like a Spitfire," says Smith, who flies the Mew Gull at a speed of 290 mph. With its recessed cockpit providing virtually zero forward visibility, "landings and take-offs," says Smith, "are a bit of a happening."



GARETH HORNE

How Things Work:

Space Stat

BY ADAM PITLUK | ILLUSTRATION BY JOHN MACNEILL

IF THE INTERNATIONAL SPACE STATION WERE A CITY, THEN THE TRUSS THAT CONNECTS ITS MODULES WOULD BE, AMONG OTHER THINGS, ITS POWER PLANT, PUBLIC TRANSPORTATION, AND CLOSED-CIRCUIT SURVEILLANCE SYSTEMS.

More than simply the frame for the other ISS components, the truss is a complex system on its own—a novel feat of engineering that is the backbone of the largest man-made structure ever put in orbit.

The main purpose of the truss is to hold solar arrays, their batteries, and necessary support systems, but it is also studded with sensors, antennas, ports for experiments, footholds

the largest of the station's remotely controlled robotic arms.

Since all the hardware is installed on Earth, as opposed to being assembled in orbit, fewer time-consuming spacewalks are needed.

The station is required to support a six-person crew and supply power for the scientific experiments, says David McCann, a Boeing structures engineer who works on the program at NASA's Johnson Space

to be hauled by the space shuttle, the only heavy lifter available at the time.

"We were able to pack the truss segments right up to the limit on the space shuttle," says McCann. "We used every ounce of ascent capability."

Traveling to the station, truss payloads are cocooned tightly inside the shuttle cargo bay, solar arrays folded. Once in orbit, the arrays open like 200-foot wings. When the ISS is completed, the truss is expected to generate more than 80 kilowatts of power.

The power systems also come with external cooling systems necessary to dissipate the excess heat the power systems generate. The waste heat comes from the switching units and transformers that regulate power to make sure each station system has enough juice.

The switching units, for example, can run for only an hour before reaching their 113.9-degree-Fahrenheit limit, while the transformers can endure 143 de-

Starboard Section 6: June 2008*

for spacewalking astronauts, and a rail system for moving man and machine.

When completed in 2010, the ISS will be four times the size of the Russian Mir, with the living space of a five-bedroom house. The 310-foot truss and attached acre of solar panels support this internal space and its tenants.

The truss, made primarily of aluminum, is being bolted into place like a massive, zero-gravity Erector set. Spacewalking astronauts have been putting pre-fabricated pieces together by hand, with help from

Center in Houston. (The company is in charge of the design and construction of all the U.S.-made parts of the station, including truss segments and solar arrays.) The mandate for a six-person habitat and numerous experimental labs determined the station's size and power requirements.

Engineers designed the truss as 11 easy-to-assemble pieces (eight are shown here)

Starboard Section 1: October 2002

grees before needing to shed heat.

While the space shuttle uses freon to keep its electrical systems and avionics cool, the ISS truss uses liquid ammonia cooled to 37 degrees and pumped through pipes and loops. Ammonia was chosen because of its stability and low freezing point.

The cooling system needs to be in place before the new pair of solar arrays, delivered in December 2006, can be

FIND OUT MORE

www.airspacemag.com

ASTRONAUTS WORKING AT the International Space Station construction site need an array of unique tools to get the job done. Just ask astronaut Joe Tanner, who learned that a single stubborn bolt can hang up a whole mission. For his story and descriptions of tools, see www.airspacemag.com.

ion Truss

brought to life. “Not just the power system, but the ‘plumbing’ also needs to work for this to happen,” says Joy Bryant, program manager for Boeing’s space station program.

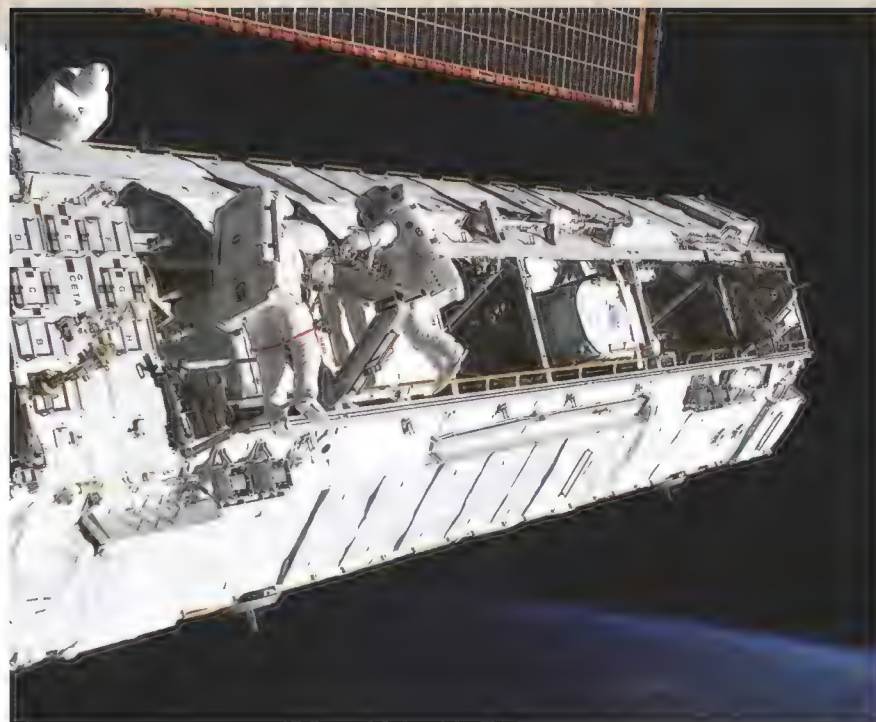
Furthermore, any work on the electrical systems must be done without interfering with the crew’s experiments, construction schedule, or safety. “It’s kind of like leaving power on in the house and rewiring the east wing,” Bryant says.

Last September’s shuttle delivery contained a literally pivotal piece of hardware, one that is necessary to maintain power for the final configuration. Astronauts installed a 2,500-pound joint, built by Lockheed Martin, that will enable the solar arrays on Port Sections 3 and 4 to turn 360 degrees in order to stay aimed at the sun.

“Since the station orbits the Earth and maintains the same orientation relative to the sun, the arrays have to rotate so they can track the sun,” says Lockheed spokesman Buddy Nelson.

“Imagine that the station is one of the seats on a Ferris wheel. As the wheel goes around, the seat retains the same orientation,” he explains. “The station essentially goes around

Astronauts from the space shuttle *Endeavour* attach the Port 1 truss section to the International Space Station in late 2002. Three spacewalks later, the piece was in place, giving structural support to the station’s radiators.



NASA

ment of space,” he says. “Almost everything on the ISS is distinctive.”

A 200-foot network of rail lines integrated into the truss’ design serves as transportation for astronauts and equipment. A mobile transporter is attached to the rails, much the same way as a roller coaster connects to its tracks, and is powered by an attached cable that unspools or reels up as the mobile transporter moves along the tracks.

The tracks lead to eight designated worksites. One of the station’s robotic arms, mounted on top of the transporter, can pluck equipment or spacewalking astronauts during station

eras and internal structural sensors to monitor the health of the station, as well as ports where temporary cameras can be mounted to oversee spacewalks. Some spare parts are also stored on truss platforms.

Engineers have placed mobile footholds around truss worksites that allow the crew to move them to different locations during spacewalks.

“One of the beauties of the [truss] is that we could lay in a lot of flexibility,” McCann says.

The world’s orbital outpost continues to grow, launch by launch. The European Union provides labs and logistics-support vehicles, Russian craft can ferry astronauts back and forth, and a piece of Canadian robotics places the newly arrived parts together.

It may take a village to raise a child, but it takes an entire planet to raise a space station.

Port Section 1: November 2002

the Earth once every 90 minutes, and the motors on the rotary joints turn the arrays at the same rate.” Nelson says the piece of equipment is unique among the many others on the station.

“The section joint is one of the largest ever made, and this is the first time one has had to operate in the harsh environ-

repairs or installation.

Also built into the truss are a slew of sensors, antennas, and ports. Most of these external boxes are part of the electrical, communications, cooling, or navigation systems. But there are also cam-

Port Sections 3 & 4: November 2006

Port Section 6: November 2000
*Date of estimated delivery.

life of



In 1932, Bill Piper dispatched his salesmen in \$1,300 Cubs. They were paid \$15 a week, given another \$25 for expenses, and admonished not to return to the factory in Pennsylvania until their airplanes were sold.

More than 70 years later, not much has changed for airplane salesmen. Now, as then, they spend countless solitary hours flying across the country in search of paying customers, who are generally wealthy, sometimes eccentric, and often unpredictable. During demonstration flights, salesmen are turning over control of their airplanes to total strangers without much knowledge of their flying abilities. Like peddling illegal drugs, selling airplanes is one of the few occupations in which a prospective customer can kill you.

When the job isn't downright hazardous, it's often wearying. Weather

strands you at small airports in the most desolate of backwaters. There you sit in a deserted Denny's on Thanksgiving, washing down your burned burger with a flat Coke. Lodging in a cheap motel, you have nothing but instant coffee, a bad television, and a weak shower for comfort, but you are so exhausted it just doesn't matter.

Still, the profession has no shortage of takers, appealing to people who don't want the 9-to-5 office life with a boss looking over their shoulders. And a top light-

airplane salesman can take home more than \$250,000 per year.

Bruce Keller knows about life on the road. He has been selling piston-engine airplanes for 35 years. Keller started working at Cessna in 1973, and aside from 1986 to 1996, when Cessna shuttered piston aircraft production, he has been with the company ever since. He calls himself "Old Bruce," and speaks with a pronounced drawl that is part preacher, part carnival barker, and a little Chuck Yeager. At major fly-ins and conventions, you are likely to see him first thing in the morning, clad in straw hat, company shirt, and khakis. He stands in front of gleaming \$241,000 Skyhawks and \$326,000 Skylanes, rings his triangle, and yells, "Cessna's open! Cessna's open!" like a cowboy cook calling, "Come 'n git it." He currently serves as a regional sales manager, as

by Mark Huber ||| Photographs by Tyson Rininger

a SALESMAN

GUYS WHO SELL AIRPLANES DON'T ALWAYS MAKE THE DEAL, BUT THEY ALWAYS HAVE THE FUNNIEST STORIES TO TELL.



At the Sun 'n Fun airshow in Lakeland, Florida, Cessna salesman Bruce Keller taps out a siren song to potential buyers (opposite), while Keith Markley of Liberty Aircraft tries a quieter approach (above). A show-goer tries a Trinidad GT on for size (left).

Arkansas airport the credit card machine for self-service fuel is hidden inside the refrigerator. And he knows where to find the keys in the beat-up

sisting company-approved dealers in a territory that encompasses Alabama, Florida, and Georgia. But Keller's beat was once the entire Eastern Time Zone, and he's worked virtually every airport pancake breakfast and fly-in along the Atlantic. "I go to fly-ins for the Flying Farmers, the Flying Physicians, the Flying Dentists, and the Flying Morticians," he says. "The Flying Morticians—now, that's quite a group."

Keller is a fount of insider information: He knows that if you buzz the airport at Carrabelle, Florida, the constable will drive out and give you a ride to Julia Mae's restaurant. He knows that at a certain

Volkswagen microbus left for visiting pilots in Luray Caverns, Virginia.

The thousands of air miles that Keller has logged have given him plenty of time to cultivate a sense of humor, one that is reminiscent of the late comic Rodney Dangerfield. "I'm a VIP member in the Super 8 motel chain," he says. "I've stayed in places that rent rooms by the hour."

"I flew a Cessna 150 from Wichita to Fort Lauderdale once—the trip took so long I grew a beard in the airplane."

"When I come home, my wife asks me to wear a name tag."

Ba-doom-boom!

Shtick aside, Keller understands what

he is peddling. "It is a way of life I am selling, not just aluminum," he says. "I want the customer to share that with me. If you look at my airplane and you sit in it, you are going flying." The lifestyle that Keller is selling centers on the ease, privacy, and get-up-and-go freedom that comes with the license to fly: If you want to travel to a new city, there's no need to adjust your schedule to a commercial airline's timetable or stand in airport security lines with the masses.

Keller's customers generally have a comfortable amount of discretionary income, and some have paid for airplanes with gym bags full of cash. One paid for a new airplane by writing a personal check on the spot. Of course, financing is available. Keller recalls demonstrating an airplane to a 94-year-old pilot in Pennsylvania: "I said, 'Now, sir, we have 20-year financing on these airplanes.' And he says, 'I like that.'"

Like those who sell almost any luxury item, airplane salesmen encounter prospective customers who often dream beyond their means and sometimes weave tall tales about their financial wherewithal. Good salesmen try to size up prospects before they invest much time and money in wooing them. Independent sales-

man Fred Ahles was trying to do just that during a telephone inquiry he received about 10 years ago. An older-sounding gentleman wanted a new, single-engine Piper Saratoga.

Like Keller, Ahles has been an airplane salesman for more than 30 years, and during that time he has sold more than 1,000 airplanes and represented almost every manufacturer. Today, Ahles is president of Premier Aircraft Sales, a Fort Lauderdale, Florida-based company that sells used and new aircraft.

The man on the phone was 200 miles away and promised, "If you can deliver a new Saratoga today, I'll take it." The brashness made Ahles suspicious, and he feared he would blow an entire afternoon and lots of fuel showing an airplane to a wannabe. Ahles began questioning the man.

"Have you ever owned an airplane before?"

"Sonny, I've owned about 35 of them."

"Really? How long have you been flying?"

"Since the 1930s."

"Do you have an airplane now?"

"I sold it."

"Really? What kind of airplane was it?"

"A 747."

"Why did you sell it?"

"The neighbors complained, said it was making too much damn noise. I kept it in my back yard."

"Why did you have the 747?"

"The 707 wasn't big enough for the elephants."

About this time, Ahles decided that perhaps the gentleman was not only unqualified to buy an airplane, but also insane. As the conversation continued, the man explained that his wife used to train exotic animals and that he also used to own a Piper Cheyenne 400 turboprop. Ahles remained skeptical, but promised that he would call the man right back. He hung up and called Piper to see if they knew anything about him.

"Fred, he's loaded," a Piper manager said. "Get your butt up there."

So Ahles flew the Saratoga from Fort Lauderdale to the man's private, 7,500-foot runway in Ocala, where he was greeted and invited to lunch at the prospect's

house, a 1920s mansion once owned by the Vanderbilts. To get there, the two walked through a tunnel in the 30-foot-tall blast wall constructed at the end of the runway for the 747. Plexiglas windows lined the tunnel, and behind one of them was the biggest gorilla Ahles had ever seen. And it did not like him.

"It sees me and goes nuts," remembers Ahles. "It comes charging at me from the other side of the Plexiglas."

The man ended up buying the Saratoga. Today, the land around what was his



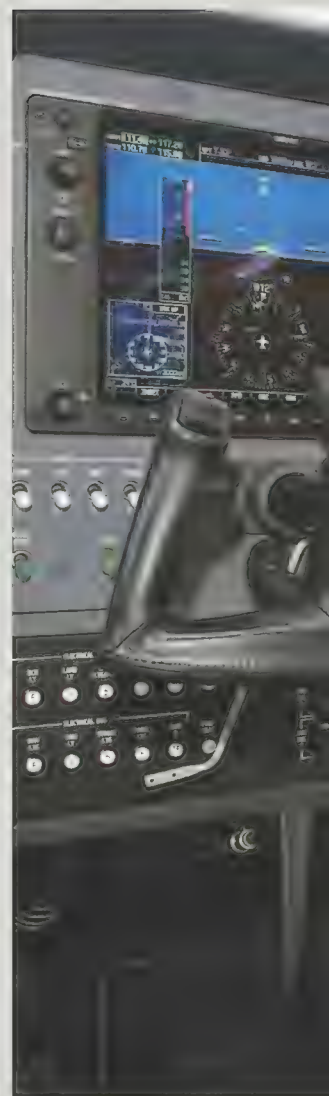
private airstrip has been converted to an exclusive fly-in community called Jumbolair. John Travolta lives there with his Boeing 707.

As Ahles learned, vetting a prospect is something of a black art. "You develop a 'gut meter' of who to qualify and who to spend your time with," says Mark Woods, a Brighton, Michigan-based Mooney salesman who typically flies 100 to 150 demonstrations annually. Woods sold Plymouths and financial services before migrating to aircraft. "Nobody is perfect, but we get it right more than we get it wrong," he says. "There are all kinds of dilapidated airports with wealthy people nearby. Just because a client is wearing a T-shirt and jeans doesn't mean that he is not financially able."

The sales cycle can be a lengthy dance, according to Woods. "There are guys I talk to for two years before they buy an airplane," he says. But two-year or two-day

Don Taylor is Eclipse Aircraft's vice president of safety, training, and flight operations (left);

Eclipse is one of many companies that offer pilot training to its customers. Many airplanes have dual controls (right), which help keep demonstration flights safe, allowing salesmen to take command of the craft if buyers get in over their heads. Salesmen love to talk about the luxurious lifestyle that comes with the product: A Beech KingAir (below) features leather seats and gold-plated cup holders.



sales are the exception. Woods says 80 percent of his sales are completed 60 to 120 days after he first makes contact with a customer.

Even trickier than gauging financial ability is assessing a customer's flying skills and diplomatically steering him into a more appropriate aircraft. During demonstration flights, salesmen are the pilots in charge, and they are responsible for maintaining safety in the air. "You generally know when to take the airplane away," says Jeff Ermish, a regional sales manager with Symphony Aircraft.



“You don’t want to insult anybody,” says Keller. “But sometimes you just go bouncing down the runway and you turn to the customer and say, ‘Good job, sir. The ELT [emergency locator transmitter] didn’t even go off.’” (ELTs automatically emit a homing beacon when an airplane crashes.)

“It’s a double-edged sword,” says Dave Bardeau, who sells Cessnas for Executive Aircraft out of Fort Lauderdale. “Your livelihood revolves around making that sale. If a person wants to buy an airplane, then, by God, they want to buy an airplane, and it is not my place to tell them they cannot or could not be in it. But on the other hand, my best customer is the one who comes back to buy repeatedly, and to that end you don’t want them to get hurt in an airplane. And you don’t want them to do something stupid, so you have to handle it. You have to tell some people what is right or wrong for them.”

In these situations, salesmen can also fall back on the authority of insurance companies. “The FAA [Federal Aviation Administration] makes the rules, and insurers enforce them to their standards, and that is a much higher set of standards than the FAA will ever create,” says Bardeau.

“You better have experience, and if you don’t have experience, you are going to get training or you are not going to get insurance. You are going to be trained to a standard that is way higher than it was in the past. That’s a good thing. It needs to happen.”

Thanks in part to insurance company pressure, most general aviation aircraft

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“Your livelihood revolves around making that sale. If a person wants to buy an airplane, then, by God, they want to buy an airplane, and it is not my place to tell them they cannot or could not be in it.”

companies offer some sort of pilot training for their customers. Mooney, for example, offers a five-day course that comes with the airplane.

AIRCRAFT SALESMEN OFTEN have a love-hate relationship with the home office. Even in the best of times, manufacturing light aircraft has always been a tough way to make money, and just about every manufacturer has been bankrupt or near-bankrupt, creating special stresses for the sales troops in the field.

Mooney has filed for bankruptcy four times since 1930, most recently in 2004. Mark Woods remembers trying to sell Mooneys as the company teetered on the edge of insolvency in 2001. Production was shut down, employees were laid off, and to Woods’ disappointment, product support for customers evaporated. “They were so leveraged and they owed everybody,” says Woods. “So when we restarted production [after bankruptcy], nobody would give us credit, and everything [for] the production line had to be bought with cash.” Production continued, slowly. Today the company is on sounder financial footing, and in 2005 Mooney delivered 85 airplanes.

According to the General Aviation Manufacturers Association, some 14,398 single-piston-engine aircraft were made in the U.S. in 1978. Then came the 1979 recession, soaring fuel prices and shortages, and double-digit interest rates. The late 1970s also saw an explosion of lawsuits filed against light-aircraft manufacturers. Virtually any time a small airplane crashed, no matter the cause, the manufacturer was sued. Settling or defending the suits dramatically raised the price of each aircraft. Manufacturers’ liability insurance rates increased, as did the rates of insurance for private pilots.

Demand for light airplanes starting dropping, and general aviation manufacturers started to scale back. By 1986, the number of single-piston-engine aircraft

produced by all U.S. manufacturers dropped to just 985.

Cessna’s light-airplane dealer network had been shrinking, and in 1986 Bruce Keller was one of only four district sales managers left. He was working in New Hampshire when the phone rang in his hotel room. The voice on the other end said, “Bruce, come to Wichita.” Keller got on the phone to his three remaining colleagues, who had all received the same foreboding call. Cessna had decided to pull the plug on piston-engine aircraft

production (the company had a much more profitable business jet division). Keller and the others were let go. "It was a tough day," he says.

Keller found work managing a small airport and later as a customer service manager for United Airlines at Washington Dulles International Airport in Virginia. The work was unsatisfying, but he can joke about it now. "My job was handling problem passengers and the FAA, and I could get the two groups mixed up."

In 1994, after much industry lobbying, Congress passed the General Aviation Revitalization Act. The legislation immunized general aviation aircraft manufacturers from liability related to defects in aircraft that are more than 18 years old. The law enticed Cessna to restart single-piston-engine aircraft production, and by 1996, "Old Bruce" was back in the saddle selling the company's Skyhawks, Skylanes, and Stationairs.

The industry, however, has yet to return to the halcyon days of 1978. Last year, the total number of U.S. single-piston-engine aircraft produced was just 2,024, a little more than double the 1986 low. Cessna accounted for 822 of the total, while relative newcomers Cirrus and Columbia delivered 600 and 114, respectively.

The introduction of sleek fiberglass composite airplanes like those from Cirrus, Columbia, and Liberty are clearly giving the old-line metal airplane manufacturers like Beechcraft, Cessna, Mooney, and Piper competition in what is already a tight market. Add in the 261 single-engine models produced last year by Canada's Diamond Aircraft, and new-line manufacturers account for almost half of all single-engine aircraft produced in 2005.

So far, the old-line companies are surviving by exploiting their name recognition and established product support. All



A potential buyer checks out a Mooney at last year's AirVenture in Oshkosh, Wisconsin (right). Salesmen, however, believe that the more serious buyers come to Sun 'n Fun in Florida (top).



of them have also adopted the "glass cockpit" technology first popularized in light airplanes by Cirrus. Cessna saw demand double for its piston singles after it began replacing "steam gauge" instrument panels with the Garmin G1000 system. So did Mooney. "Your product doesn't have a shelf life today if it doesn't have a glass panel in it or you have plans to put it in there pretty darn quick," says Mooney's Woods. "If you let your product go stale, you're dead."



Joe Walker, president of Adam Aircraft, hopes to find customers who can afford his company's \$1.2 million twin-piston-engine, six-seat A500.

"Cessna called me and asked my opinion about glass cockpits," says Cirrus chairman Alan Klapmeier. "I told them it was the best thing we did, and they should definitely go for it.

"I guess I shouldn't have done that," he jokes.

Thanks to glass instrument panels, Woods thinks the older airframers will remain competitive. "Our airframe is a mature, seasoned airframe," he says, slipping into his sales pitch. "But basic aerodynamics have not changed. Compared to the new airplanes today, our product is more efficient, goes faster and higher on less fuel, and further."

The tension between old and new manufacturers comes to a head each April at the annual Sun 'n Fun airshow in Lakeland, Florida. Spring is the start of the light aircraft flying season, and while thousands of "tire kickers" attend the Experimental Aircraft Association's larger July airshow in Oshkosh, Wisconsin, proportionately more pilots come to buy at the smaller Sun 'n Fun. And the manufacturers know it. Cirrus deploys an army of salesmen and five aircraft dedicated to giving demonstration rides at Sun 'n Fun, and Cessna has built a permanent pavilion at the Lakeland site. Other manufacturers, including Columbia, set up shop at the airport in nearby Plant City: A smaller volume of air traffic there during the week of Sun 'n Fun means more opportunities to take prospective buyers on demo flights.

Depending on the size of their territories, most salesmen attend 20 to 30 air-

shows and fly-ins a year. Another way to find buyers is to maintain contacts with flight schools, and a third great source of leads is the base of customers whom you've already sold to. However salesmen hook up with potential buyers, it still comes down to "butts in the seat": The more people you fly, the more airplanes you sell.

On a Saturday morning last April, Columbia salesman Duncan Jones showed off a \$579,000 top-of-the-line Model 400 to a particularly hot prospect, Tim Bak-

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er, an anesthesiologist from Lafayette, Louisiana. Baker has been flying for 28 years and has owned several aircraft. He currently flies a Cessna 182. If the Columbia flightline at Plant City were a Las Vegas casino, Baker would be considered a "whale," a high-roller.

Baker and Jones hopped into the cockpit of the slick, 270-mph, low-wing rocket, fired up the engine, and started scrolling through the computerized pre-launch checklist that popped onto the multi-function display of the Garmin G1000 glass panel system.

"I like this," said Baker. "I own Garmin stuff."

Jones could not contain himself, say-

ing, "Well, you need to order one—now." Baker ignored the entreaty and asked a question about the display system. Less than five minutes later, he snapped the Model 400 off the runway and settled into a brisk climb of 1,600 feet per minute. Before they had leveled off at 7,300 feet, Jones had already enumerated the features and benefits of the aircraft's flight control system, which the aerobically trained Baker put to the test. He pitched the nose up 30 degrees, then threw the airplane into a hard left turn. As Baker continued to yank and bank, a slight smile formed on his lips. Jones talked Baker through a stall and popped the speed brakes, whereupon the airplane entered a steep descent: 4,500 feet per minute.

Toward the end of the 45-minute flight, Baker mentioned a few things he didn't like about the Model 400, but Jones was relentless. "So do you know what color you want?" he asked. "I'm color-blind," Baker shot back.

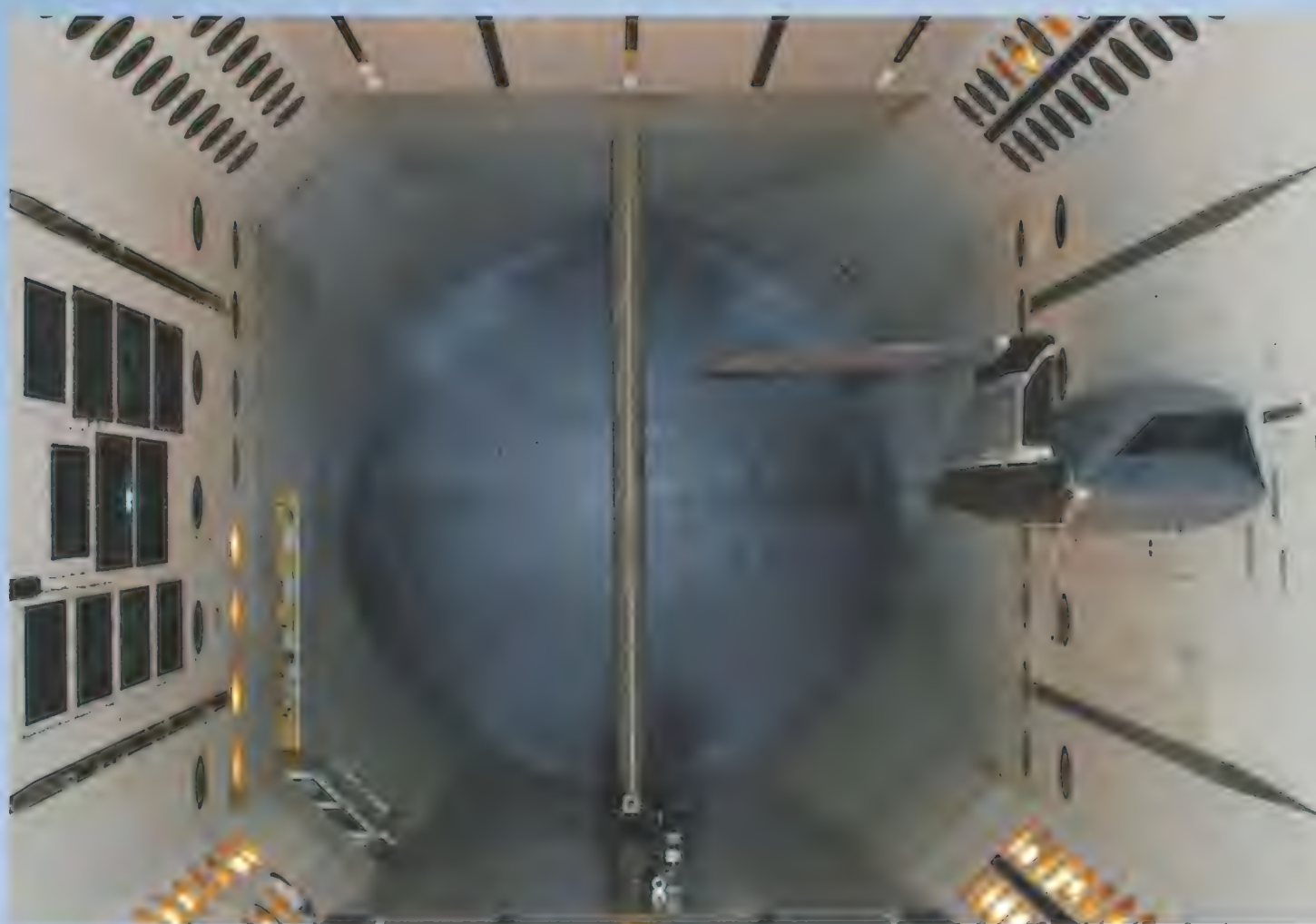
Eight months after his demo ride, Baker has not decided if he wants the airplane, which is not atypical. Only around 10 per-

cent of all demo rides lead to a purchase.

There are times when a salesman knows there is no hope of a sale, but he flies someone anyway. Many years ago, a man came to an airport where Bruce Keller was giving demo rides. He had never seen a new airplane and had never been up in an airplane at all. "You could tell this fellow was having a tough time with life," says Keller. "He had on striped pants and a plaid shirt. We talked a bit, then I put him in the right seat and we went flying. He told me he couldn't buy an airplane, and I told him I wasn't asking him to. To this day, I still get a Christmas card from that fellow. It meant a lot to him, and it meant a lot to me." —

W SHIFTERS

DR AI HS



SHAPE-MEMORY POLYMERS AND OTHER TECHNOLOGIES MAY CREATE AN AIRPLANE FOR ALL MISSIONS. BY MICHAEL MILSTEIN

NO AIRCRAFT EXCELS IN ALL CONDITIONS, which is a pity because if one did, it would rule the world. Commercial airliners, for example, which are designed to cruise at high altitudes over long distances, make lousy fighters. But the day is soon coming when one aircraft might do the job of two—or many more.

New “morphing” technology promises adroit aircraft that reshape themselves, bird-like, in flight. University and industry researchers funded by the Defense Advanced Research Projects Agency and others are experimenting with wings and helicopter rotors that fold, shrink, extend, tilt, and twist in flight. It’s a breakthrough in airplane design that would let a single airplane take on the persona of a bomber one moment, a fighter the next.

“Morphing lets one type of airplane do all types of missions,” says Rick Lind, an assistant professor of mechanical and aerospace engineering at the University of Florida. His team has built small remote airplanes that morph in a half-dozen different ways. One folds its wings—first into the shape of an M for steady, stable flight. Then it reverses them—in 15 seconds—into a W, making it so maneuverable it turns on a dime. The research is funded by the Air Force, which wants remote aircraft that can wheel through cities like hawks.

The trick to making it work is finding a way to muscle into entirely new shapes without losing control of the airplane. That’s not hard for Lind, whose airplanes are featherweight and flexible—nylon fabric over a carbon fiber frame. But for bigger aircraft it takes much more: wings limber enough to morph but tough enough to carry plenty of weight, a light but strong power system to reconfigure the wings in flight, and smart flight controls able to adjust to changing aerodynamic conditions.

Morphing wings have been around since the Wright brothers, who controlled their *Flyer* by twisting the wingtips. In 2005, the Air Force, NASA, and Boeing wrapped up tests on an F/A-18 Hornet that twisted its wings to roll at high speeds. But DARPA is after far more dramatic morphing, hoping to alter wingspan and wing area by at least 50 percent.

One promising approach is aimed initially at helicopters, not airplanes, and takes after one of nature’s creations: plants. Flowers angle their stems by shifting fluid from one cell to another. Lithium batteries also change shape as ions flow in and out of them when they are charged and discharged. You may not notice the batteries changing shape, but “your cell phone designer and your iPod designer know about it and design around it,”

LOCKHEED MARTIN

says Yet-Ming Chiang, a professor of materials science and engineering at the Massachusetts Institute of Technology.

Chiang and colleague Steven Hall took advantage of the shape-changing nature of batteries by building the same materials into a model of a Blackhawk helicopter

RICK LIND, UNIVERSITY OF FLORIDA



blade. They found a small dose of energy could reshape the blade, altering the angle of its trailing edge to give it more lift. That's great for hovering, but the blade doesn't need as much lift in flight mode. A morphing blade could simply return to its original shape when it's time for the helo to fly away.

The MIT team, now awaiting a DARPA decision on further funding, is still a long way from a full morphing helicopter. But the research shows shape-changing battery materials are lightweight, hold up under tremendous strain, and aren't bothered by the frigid temperatures of high-altitude flight, Chiang says.

But if morphing is so great, why is it only taking off now? It hasn't been much of an option before, since the stress of high-speed flying demands tough airframes with little flexibility in the air. So designers built different airplanes for different purposes: fuel-efficient, long-winged reconnaissance craft and high-speed fighters. The trouble is, the multi-aircraft approach can be cumbersome on today's battlefields.

"If you're a unit pinned down in Iraq, you don't want to wait an hour" for help, says Terry Weisshaar, manager of DARPA's morphing aircraft structures program.

That urgency is merging with advanced new materials into shape-shifting schemes that could outmaneuver rigid-winged foes. A Lockheed Martin design starts out with long wings with plenty of lift and maneuverability. Then the wings fold up. The inner half nests into the fuselage, leaving the outer half as a shorter wing better suited for high speed. So far it exists only as a wind

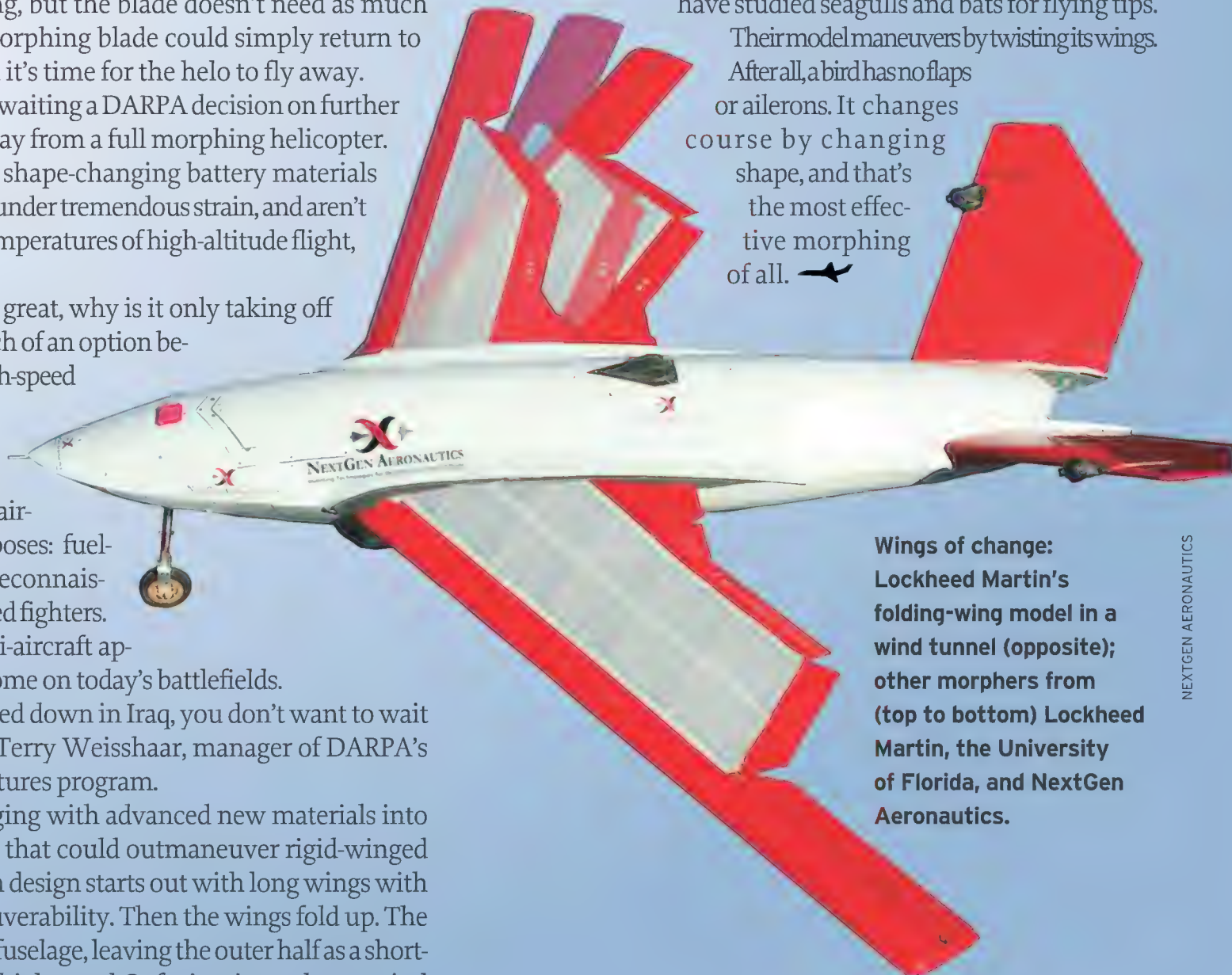
tunnel model, but it's loaded with new features. A polymer expands when heated by an electrical current, which reshapes the leading edge of the wing. The wing has a seamless skin, so when its joints move, gaps do not open up and create drag. One option is a "shape-memory" polymer that relaxes to allow movement and then stiffens back into shape.

Lockheed's main competitor in morphing research, NextGen Aeronautics in Torrance, California, devised latticework wings with stretchable skin that sweep back, bat-like. NextGen is now designing an unmanned model that can not only morph in flight, but also shift shape to make sharper turns and steeper climbs.

If it's a trick to morph an aircraft, imagine piloting the thing. Flight controls usually depend on predictable responses: Bank right, and the airplane turns right. But it may not if the wings are shifting shape at the same time. "If you shape-change too quickly, you destabilize the whole aircraft," says Ephraim Garcia, a Cornell University mechanical and aerospace engineer.

So engineers must devise smart flight control systems that adapt seamlessly to changes in the airplane during flight, something birds do instinctively. Lind and his students have studied seagulls and bats for flying tips.

Their model maneuvers by twisting its wings. After all, a bird has no flaps or ailerons. It changes course by changing shape, and that's the most effective morphing of all. →



Wings of change: Lockheed Martin's folding-wing model in a wind tunnel (opposite); other morphers from (top to bottom) Lockheed Martin, the University of Florida, and NextGen Aeronautics.

LOCKHEED MARTIN

NEXTGEN AERONAUTICS

we Recycle

USED AIRPLANE PARTS CAN APPEAR IN THE STRANGEST PLACES.
BY LEE ANN TEGTMEIER





LEFT: SAM CHUI; ABOVE: TUCSON IRON & METAL

DEEP IN THE ARIZONA DESERT, a grapple at the end of a 25-ton excavator chomps into an aircraft fuselage, crunching the metal before hoisting and dropping it into a nearby dumpster. It swings back for another bite of aluminum, which crackles as it rips away from the hull. The excavator continues ingesting until all that remains are the blocks on which the airplane shell once stood.

It's the humiliating end for another stripped aircraft at the busy Evergreen Air Center in Marana, Arizona, which dismantles between 24 and 48 commercial aircraft a year. But thanks to emerging advances in the aircraft recycling industry, some parts that otherwise would end up in a landfill could find new life as transformed products. If new carbon fiber recovery techniques can be refined, aircraft composites in ailerons, elevators, and rudders may be converted into computer laptop cases, cell phone cases, or even skateboards. The technology is close to becoming

End of the line: Commercial airliners parked in Marana, Arizona, are stripped of their parts (left), some of which will be turned into other products. Above, an excavator tears into the aft fuselage of a Boeing 747 to break it up for scrap.

commercially available, says Ron Allred, president of Adherent Technologies in Albuquerque, New Mexico. "The technology is ready; we're just waiting for an investor," he says.

Finding new uses for old airplanes is the mission of recycling centers like Evergreen, located 37 miles north of Tucson. The facility is one of the biggest and busiest aircraft dismantlers in the country. "Right now, we have a bigger backlog than we've ever had," says Jim Toomey, the company's president. "It could just be a spike, but I don't know. If it goes this way through spring, I'll definitely think there's something really going on. A lot of these planes are just about obsolete, so maybe they're just trying to get any value they can out of these parts before they terminate the airframe."

The line to the excavators is growing. An estimated 6,000 to 8,000 commercial aircraft—mostly wide-bodies—are expected to be retired worldwide in the next 10 to 20 years, according to Martin Fraissignes, general manager of France's Chateauroux Air Center, another aircraft recycler.

That's a lot of material to chomp. It's also a lot of material that, left unattended, could become an environmental haz-

ard or, if uncertified, pose a safety risk if reflight. That's why recyclers like Evergreen and Chateauroux last June joined forces with nine other U.S. and European manufacturers to form the Aircraft Fleet Recycling Association. The group is seeking to develop best-practice standards to manage retired aircraft parts.

The good news, as recyclers and aircraft operators see it, is that about 80 percent of all commercial transport aircraft material can be reused in some fashion. "There are a lot of materials that are very valuable in aircraft. I mean, really valuable, and you need to know those," says Toomey. "If you're just taking apart a plane, you could be throwing away \$40,000 to \$50,000 worth of stuff."

The bad news is the risk of worn-out parts being reflight, particularly in countries where aviation oversight is lax. "Bootleg parts, especially in Third World countries, already are a problem," says Toomey. For parts that are inspected, found to be no good, and then thrown in the trash, he says, "somebody could pull them out and try to sell them" to aircraft parts suppliers.

That's where the new association comes in. Its mission is to develop and encourage aircraft recycling practices that are both economically viable and environ-

mentally sound. So far, the industry is responding; within months of the group's launch, between 20 and 30 parts suppliers or manufacturers in the United States and Europe expressed interest in joining. Nineteen have already become members and AFRA expects at least five to 10 more companies to join this year. Committees within the association are working to set standards for retiring aircraft and to lay down technical recommendations for reusing parts.

"I think that [AFRA] will help people in how they take planes apart," says Toomey. Association members are likely to avoid doing business with individuals or companies that are "not legitimate," he says. But "a crook is a crook, and they're going to figure out ways to forge paperwork and do whatever they want."

Airbus and its partners are setting up a center at Tarbes Airport in southern France to look for the best ways to decommission and recycle aircraft. Airbus' project, called PAMELA (Process for Advanced Management of End-of-Life Aircraft), has the same aims as AFRA, but Airbus is controlling the process, rather than collaborating with the partners.

At a center like Evergreen, it typically takes about a month to dismantle a Boeing 747. Workers first have to park the air-

craft on a cement slab to keep hydraulic fluids and other toxic substances from seeping into the soil. Then, Federal Aviation Administration-certified airframe and engine mechanics go through it and remove every usable part: "the wings, flaps, ailerons—everything that can be taken off," says Toomey. Those items, along with the avionics, are tagged with their serial numbers and sent to used-aircraft parts suppliers such as The Memphis Group in Tennessee and Volvo Aero in Sweden for resale.

Parts most in demand include engines, landing gear, winglets, and avionics. Second-hand-parts suppliers with FAA repair station certificates can refurbish and recertify those parts with service life remaining. Once the usable parts are out of an aircraft, mechanics go in and rip out the guts—including miles of wiring—and toss them into dumpsters. Then the shell is hoisted on top of blocks and the grapple and shears start devouring. The munching takes about 10 days for a 747.

RIGHT: JIM NEWTON; OPPOSITE: MICKEY BEDNAR



Commercial aircraft such as this worn-out Boeing 747 can provide a range of consumer products from such areas as its fuselage, engines, flaps, and ailerons.





A pair of chopped 747s (left) keeps watch in Marana, Arizona. Below, recyclers can strip and refurbish the usable avionics from the cockpit of this out-of-service 727.



"It's three stories tall and you can't just start chomping at it because it would fall over and kill you," says Gary Kippur, president of Tucson Iron & Metal, which works with Evergreen.


The aluminum remains of a 747, worth at least \$20,000, will fill five 50-foot trailers; an early-model 737 will fill just one. Tucson Iron & Metal then drives those trailers to a secondary smelter, TIMCO, in Fontana, California, which melts the

aluminum and separates it into ingots by specific chemistries, says Kippur. The metal then can be recast into such everyday things as car wheels, automobile transmission casings, or lawnmower engines.

New technologies that can sort aluminum by alloys or recover carbon fiber from composites are extremely timely, not only because of the volume of predicted aircraft retirements in the next

decade, but also because the price of raw material—particularly for composites—is rising. Aerospace-grade carbon fiber, for example, sells for about \$25 per pound. But, unlike aluminum, composites can't just be crunched, melted, and recast. They have to be broken down under heat in a complicated process that turns them into a sort of hydrocarbon "soup." From there, the various resins can be separated and mixed with other substances to produce recycled carbon fiber, which can be used in the wood products industry.

Wringing the most use out of old aircraft parts is a major issue for both dismantlers and manufacturers, such as Boeing, which is using a significant amount of composites on its new 787 Dreamliner. The aerospace giant already is working with Milled Carbon in Britain and Adherent Technologies in New Mexico, both of which are developing carbon fiber composite recycling technologies, and Boeing is manufacturing the 787 with recycling in mind, says Bill Carberry, Boeing's project manager of aircraft and composite recycling. Carberry is enthusiastic about the prospects for composite recycling. "Boeing is confident that [the technologies] will provide an environmentally preferred alternative that will dramatically increase the value of end-of-life aircraft," he says.

If recyclers have their way, the commercial airliner you fly today—or pieces of it, at least—could wind up as tomorrow's building material for your house, deck, car, or cell phone. 



Aircraft aluminum now can be melted and recast to make lawnmower engines or wheels for automobiles. New technologies may soon allow aircraft composite material to be turned into computer laptop cases, cell phone cases, or even skateboards.

In the Footsteps of the **MIGHTY EIG**

A WRITER SEARCHES SOUTHERN ENGLAND FOR TRACES OF A LEGENDARY



HTH

WORLD WAR II AIR FORCE.



AN AMERICAN SEEKING THE GHOSTS of the U.S. Army's Eighth Air Force in eastern England can get lucky or get lost. I'd found my way to Rattlesden, a tiny village about 80 miles northeast of London, and I'd stopped at the Rattlesden post office and gotten fine directions to a nearby airfield. But within minutes of taking off in my rented car, I was lost. Miles later on a narrow farm lane, I asked the way of a man who'd pulled his car onto the grassy "verge" to let me pass. An abandoned U.S.

BY JOHN FLEISCHMAN

Army Air Forces airfield? The B-17 base that launched 257 missions and lost 153 aircraft during World War II? Right-hand driver's window to right-hand driver's window, he set me straight. I soon went wrong.

The day before, I did find the well-preserved remnants of an Eighth Air Force base at Thorpe Abbots. It's between Eye and Diss, not far from Dickleburgh, though I'm not sure I could retrace my route. Fortunately, I'd called ahead and been briefed on the Dickleburgh bypass. The all-volun-



LEFT: ALAMY; BLACK & WHITE PHOTOGRAPHS: NATIONAL ARCHIVES; COLOR PHOTOGRAPHS: JOHN FLEISCHMAN

A tour of Eighth Air Force history wouldn't be complete without visits to Bassingbourn, where the B-17 *Memphis Belle* was based (above), and Duxford, which has an operational control tower and *Sally B*, a still-flying B-17.

teer keepers of the Eighth Air Force's 100th Bomb Group Memorial Museum at Thorpe Abbots knew I was coming.

Rattlesden and Thorpe Abbots are in Suffolk, one of five counties that make up the old Saxon kingdom of East Anglia,

which juts into the North Sea. Flat, heavily agricultural, and perfectly placed for launching mass formations of propeller-driven, high-altitude heavy bombers deep into German territory, East Anglia was the cannon's mouth for the U.S. Army's

Eighth Air Force. Sixty years on, it remains the heartland of the Eighth Air Force legend.

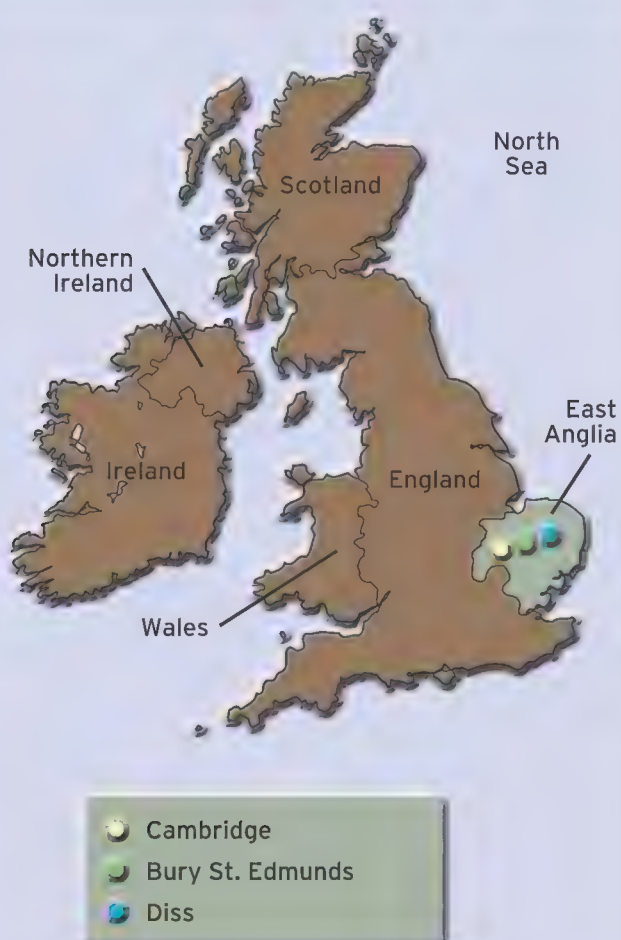
The U.S. military presence in the United Kingdom during World War II was immense. Between 1941 and 1945, three million U.S. servicemen and -women flowed through Great Britain (with the Yanks taking 50,000 British war brides and a few war grooms in passing). By itself, the U.S. Army Air Forces contributed 500,000 personnel to this "friendly invasion," with 350,000 of those in the Eighth Air Force alone. Compared with U.S. service personnel in other regions of England, the Eighth Air Force arrived earlier, stayed later, and settled more heavily in East Anglia. In 1944, one in seven residents of Suffolk County was American.

When I pulled up to the 100th Bomb Group Memorial, volunteers Ken Everett and

Carol Batley were waiting at the far end. Batley was clutching the heavy metal lariat of keys that it takes to pass through the layers of padlocks, deadbolts, and alarm boxes that guard what remains of the Eighth at Thorpe Abbots today. Gone are the concrete runways, hardstands, hangars, barracks, mess halls, bomb dumps, fire-fighting ponds, and, of course, big-tail Boeing B-17 bombers. What remains is the control tower, the quartermaster's store, and a row of rescued and relocated Quonset huts (the British call them Nissen huts). In the old tower and its highly eclectic museum I began to feel what life must have been like for the young Americans who once lived here and for the English people who watched them fly off to battle every morning.

"I was 13 when they came in 1943, just the right age to be fascinated by it all," says Everett, who points out the house just beyond the vanished perimeter fence where his family was living when the four squadrons of B-17s that made up the 100th Bomb Group began operations from Thorpe Abbots. He vividly remembers standing outside and watching a shot-up B-17 fly by at rooftop height, popping flares, leaking fuel, and jettisoning gear as it swooped in for an emergency landing. Everett was delighted by the sound and spectacle. "At that age, you don't appreciate the danger," he says. Then one

The Eighth in England



F. MATTHEW HALE



afternoon, while cycling home from school, Everett watched a B-17 sail across the road just in front of him, crashing about 300 yards away. Seven of the 10 aboard were killed. He also recalls the day a 100th Bomb Group gunner, standing outside his ball turret, accidentally set off the .50-caliber gun, spraying rounds at the village. “I have this recollection of hearing this sound—*bing, bing, bing*—overhead,” says Everett. “You weren’t aware that you were threatened until it was over.”

In 1977 Everett was one of the first volunteers that Mike Harvey, another local boy, lured into what seemed a hopeless mission to rescue the Thorpe Abbots control tower. Harvey had been only seven in 1943, but he too had many memories of the U.S. air crews. Before his death in 1995, Harvey gave his energy and mad dreaming to preserving Thorpe Abbots. The English farmers who took back their fields after the air station closed in 1945 stored straw for pigs in the derelict tower. The glass house on the tower roof had disappeared. Cracks and water damage were everywhere.

Demolition seemed most likely until Harvey approached the landowner with a plan to restore the tower as a museum commemorating the Eighth’s 100th Bomb Group. The owners gave Harvey a 99-year lease on the tower and a small footprint of land around it. (“We have to return the land in good condition when we finish,” says Everett.) Harvey rounded up other locals with good memories of the Yanks and those with no memories but lots of curiosity, like Ron and Carol Batley, post-war baby boomers. Ron was immediately taken with Harvey’s ideas, but Carol’s first reaction was “You must be crazy.” Then Harvey’s volunteers, including Carol’s husband and her children, descended on the Thorpe Abbots tower with new glass, paint, and roof tar. Carol soon changed her mind: “If you can’t beat them, you had to join them. But you have to bear in mind that none of us had any experience in keeping a museum.”

Harvey knew that to get the museum going, he had to get the 100th Bomb Group

The Eighth Air Force mounted a “friendly invasion” of East Anglia (opposite, top), sending 350,000 personnel to more than 100 bases, including the air station at Duxford.



Two flares (visible in the upper left corner of the photo) fired from a Boeing B-17 on final approach alert ambulance crews that some of the bomber’s crewmen are wounded.

Local volunteers have restored the control tower from the Eighth airfield at Thorpe Abbots (right).



veterans’ association on his side. In the late 1970s, he began cultivating Harry Crosby, the group’s former navigation officer, and Robert “Rosie” Rosenthal, by then quietly practicing law in the New York City suburbs. Rosenthal had volunteered for two tours with the 100th, flown a series of wrecks to safety, and been shot down twice, the last time over Berlin.

When Crosby and Rosenthal gave the thumbs-up to Harvey’s tower museum at Thorpe Abbots, attics across the United States opened and out came a flood of artifacts. Rosenthal sent his dress uniform and his formidable array of medals. A bombardier sent the 35 bomb tags he signed for on his 35 missions, all mounted on a map of Germany. Then came flak jackets, a Norden bombsight, a never-opened GI shaving kit, the Boeing name plate off a pilot’s control wheel, a metal rooster “acquired” from a nearby pub, and the key to the 1141st Quartermaster Company’s storeroom at Thorpe Abbots. Along with the memorabilia came more than 2,000 pictures, bundles of letters home, and a war’s-end telegram to the mother of a 100th Bomb Group POW: “The Secretary of War desires me to inform that your son S/Sgt Affleck, John W.,

has returned to Military Control.”

Museum volunteers dragged the old fire-fighting pond, recovering a bugle, a virtual market basket of 1940s consumer products (Ipana toothpaste, Brylcreem, Old Spice aftershave, little green Coke bottles), a horseshoe, and a copy of Fulton Sheen’s *The Armor of God*. The people around Thorpe Abbots brought in bits and pieces from the 100th Bomb Group that had rained down on the land or were left behind in the outfit’s hasty departure. Locals came bearing U.S. Army-issue office furniture, telephones, tools, stepladders, bomb hoists, aircraft sheet metal, bent propellers, and a gas-attack rattle and all-clear bell complete with a sign warning, “These are not playthings.”

To me, the most amazing artifact was a well-worn Army-issue catcher’s mask that a homeward-bound GI gave to a local schoolboy at war’s end. Combat air crews who survived their mission tours were immediately sent home, but many of the enlisted men who came to Thorpe Abbots in 1943 were still there in 1945. What’s an English schoolboy to do with an enlisted man’s catcher’s mask? Save it for 50 years, then return it to the Eighth Air Force.



Ken Everett (whose reflection is seen in a reproduction of bomber nose art at Thorpe Abbots) was 13 when the Eighth's 100th Bomb Group arrived in his hometown in 1943. "I was just the right age to be fascinated by it all," he says.

THERE ARE AT LEAST a dozen other volunteer museums and memorial societies scattered across East Anglia; they too preserve U.S. Army Air Forces sites. Few associations are as active or as well organized as the 100th Bomb Group Memorial, though. Some don't have towers to guard, and, like volunteer groups everywhere, their enthusiasm and activity ebb and flow. Most volunteer museums are open to visitors only one or two days a month, mostly on Sundays and mostly in summer. The Internet is invaluable in locating them, but luck helps. I got lucky the next day.

I went looking for Rougham, hoping for no more than a peek through the window of the museum there, which is dedicated to the Eighth Air Force's 94th Bomb Group. My tourist map of old Eighth Air Force fields said that the museum is run by a Rougham Tower Association on an industrial estate just outside the town of Bury St. Edmunds. I spotted the exit for the Rougham Industrial Estate just in time and turned onto a street on which every vertical surface bore a poster announcing that today was the start of the two-day



FRED PRELLER/384THBOMBGROUP.COM

In 1983 St. James the Apostle Church installed a stained-glass window (left) honoring the 384th Bomb Group, which flew B-17s out of an Eighth Air Force station at Grafton Underwood in Northamptonshire. The window depicts a B-17 flying along the English coastline as it returns from a combat mission.

Rougham Airshow. The Rougham tower wasn't just open,

it was jumping. Inside, the association's self-trained curator, Peter Langdon, gave me a tour of the sandblasted, patched, re-glazed, re-roofed, and repainted tower. Outside, the association chairman, Graham Crabtree, showed me how a proposed highway bypass would shave the corner of the historic zone around the Rougham tower.

The climax of the airshow would come the next day, I was told, when a flotilla of warbirds would descend on the Rougham airfield, including Spitfires, a Messerschmitt, a P-51, and a B-17 named *Sally B*. In the meantime, a World War II-era motor pool was already assembled on the field behind the control tower, ready for

my inspection. I marched down a long line of parked U.S. jeeps, half-tons, staff cars, dispatch motorcycles, and an M24 tank. Elsewhere I saw vendors selling hot dogs, replica USAAF patches, model airplane kits, and Glenn Miller's greatest hits. Straying beyond the day's theme, other vendors were selling Thai noodles, classic car parts, contemporary war surplus, medieval replica swords, toy trains, helicopter rides, and two chances for £1.50 to ride an "unrideable bike."

In the afternoon, the Rougham Tower Association would dedicate a new monument to the 94th Bomb Group, using an

Football was one way maintenance crews at bomber bases passed the time between missions. The tents served as sleeping quarters.



engine from a 94th B-17 that had spent the last 60 years underwater. In 1944 the engine belonged to *Hello Mr. Maier*, which had taken off from Rougham, attacked Munich, and ditched in the North Sea on the way back. The entire crew was rescued, but the engine didn't turn up until 2000, when an English fishing boat snagged it from the bottom of the sea. Its years in the sand had half turned it to stone. The repainted engine and propeller had now been made into the centerpiece of the new monument thanks to the volunteers of the Rougham Tower Association, who have been working since 1993 to save the old control tower from ruin.

Relying on fundraisers, hard work, and a 99-year lease from the supportive landowner, the volunteers have restored the concrete tower's wartime appearance, repainting the tower a very authentic Army green. The restoration evoked the days when the tower controlled the B-26 Marauders of the 322nd Bomb Group and then the heavy B-17s of the 94th. The volunteers forged ties with U.S. veterans, filling the new tower museum with donated artifacts. They redid the old radar repair shop as a meeting hall and filled restored Quonset huts with the larger Eighth Air Force artifacts that still surface in old barns and new construction sites: a bombardier's seat, a bomb winch, and a large piece of *Little Boy Blue*, a B-17 that crashed near Rougham. The piece had been brought in by a man who said he'd been using it for decades to cover his lawnmower.

The Rougham Airshow had something on display last August even rarer than Brylcreem bottles—an Eighth Air Force combat veteran. Wilbur Richardson, a retired music and history teacher from Chino, California, was on hand for the memorial dedication, still able to fit into his USAAF sergeant's uniform. Richardson first arrived at Rougham in early 1944, as the 21-year-old ball turret gunner on a B-17 named *Kismet*. He was about to start a 30-mission combat tour. Twenty-nine missions later, Richardson went to London on a 48-hour pass. "By the time I got back to Rougham," he recalls, "they'd raised it to 35 missions." On his 30th mission, Richardson was severely wounded by flak over Munich and shipped home.

Last summer, he was making his 15th return to Rougham, looking sharp enough for many more. But the ex-ball turret gunner's appearance raised a question: What will happen to the Eighth Air Force legend as the flyboys fade away?

Legends are not always fair or even accurate. The U.S. Army deployed other air forces in Europe during World War II. There were two tactical air forces, the Ninth, which was based

originally in England, and the Twelfth, which is better remembered as the desert air force after its start in North Africa. The Eighth was not even the only strategic air force. In 1943 the Fifteenth Air Force was set up in Italy to carry out the same kind of high-altitude, long-range strategic bombing that the Eighth was waging from England. These other U.S. Army Air Forces fought valiantly, but the Eighth turned

On November 6, 1943, a turkey farmer in Norfolk County allowed a group of Yanks to select birds for the upcoming Thanksgiving dinner at their air station.

Three months after the war in Europe ended in 1945, the base at Duxford celebrated with an airshow. Despite being named *Contrary Mary*, a North American P-51 attracted many admirers.



out to be the one that flew into legend.

On these and other issues, the American Air Museum in England is a useful corrective. And it's not hard to find. It's at Duxford, just off the M11, between London and Cambridge. The American Air Museum is actually part of the Imperial War Museum, the British equivalent of the Smithsonian Institution's National Air and Space Museum in Washington, D.C. Inside, I sought the iconic aircraft of the U.S. Army Air Forces. The American Air Museum covers the full range of U.S. flying in Europe, from a SPAD XIII in Ed-

die Rickenbacker's 94th Aero Squadron colors to a recently retired SR-71 Blackbird reconnaissance aircraft. But the knots of visitors are always thickest by the signature airplanes of the Eighth Air Force—a green-painted B-17G named *Mary Alice* and a bare metal B-24M Liberator named *Dugan*. Hanging from the ceiling was a P-51D Mustang painted with the checkered nose markings of the 78th Fighter Group. I studied a photo of 78th pilots lounging outside the group briefing room, waiting in the late afternoon sun at Duxford to see who didn't make it home from

the day's mission. I turned from the photo to look out on the Duxford main runway beyond the glass. They waited just out there.

England is knee deep in history, and wading through it in a search for the Eighth Air Force can take you to unexpected depths. It can lead to All Saints' Church, in the village of Carleton Rode, which has a glorious stained-glass window commemorating 17 U.S. airmen killed when their two B-24s collided overhead in November 1944. It can lead to pubs like The Swan in Lavenham, where crews from the 487th Bomb Group signed the walls. Sixty years later, the signatures are still there, safe under glass. (The Swan is now part of a swank hotel, its staff and patrons too young to remember the pub's wartime customers.) Everywhere I went, there was the East Anglia summer sky, a turbulent kaleidoscope of sudden blue, sudden cloud, and sudden squalls.

The rain lifted for the short drive north from Duxford to Cambridge. I exited the highway just west of the university city, into the leafy suburb of Madingley, where I was bound for the Cambridge American Cemetery and Memorial, the resting place for 3,812 American servicemen and -wom-



When equipped with auxiliary fuel tanks, Lockheed P-38 Lightnings (below) had the range to serve as fighter escorts for the Eighth Air Force's long-range bombers, including the B-17, one of which is on exhibit at the American Air Museum in Duxford (left).



en (along with a scattering of U.S. War Department employees, Red Cross workers, Merchant Marine sailors, and one war correspondent) whose bodies were recovered in the United Kingdom during World War II. Another 5,126 are listed on the Wall of the Missing.

The American Cemetery is operated by the U.S. government's smallest independent overseas agency, the American Battle Monuments Commission. By law, the cemetery's superintendent and his assistant are American, but the other staffers are local, including cemetery associate Arthur Brookes. No one knows more about the dead and the missing honored at Cambridge than Brookes does. He knows where to find bandleader Glenn Miller on the Wall of the Missing, listed as Major Alton G. Miller, USAAF Band. There is the name of John F. Kennedy's elder brother, Lieutenant Joseph P. Kennedy, cut in stone among the U.S. Navy missing. Buried here are 17 women, 32 civilians, and someone from every state in the Union, plus the Panama Canal Zone and Puerto Rico. Twenty-four of the burials are unknown.

Brookes says that the American Battle Monuments Commission D-Day cemetery at Colleville-sur-Mer in Normandy draws the most visitors—three million a year—but the American Cemetery at Cambridge, which is the only U.S. World War II cemetery in the United Kingdom, still gets 150,000 visitors a year. Roughly 70 percent of the burials drew from the U.S. Army Air Forces, and most of those came from the Eighth Air Force. On the memorial for the missing, however, the percentage of Eighth members is much higher: It was in the nature of the Eighth's long-distance bombing campaign, says Brookes, that many fell unseen into remote country, coastal waters, or their burning targets below. By war's end, more than 10,000 Americans had been buried here. In 1945, the U.S. government offered the next of kin of deceased overseas personnel the option of repatriation; about 60 percent accepted.

Yet the buried and the missing at Cambridge represent only a fraction of the Eighth's 26,000 dead. Approximately 135,000 Eighth personnel flew combat missions. That means an Eighth air crew



At war's end, U.S. military dead in cemeteries across Britain (above) were either repatriated or moved to the Cambridge American Cemetery and Memorial (right), where they are represented by nearly 4,000 marble crosses and Stars of David.

member had roughly a one-in-five chance of dying. Factor in another 29,500 air crewmen who were shot down, ending up as POWs and internees. Suddenly, the scale of the Eighth's sacrifice becomes terribly clear.

I walked on, following the curved rows of graves; it is a beautiful place. The design is American—both the architects and the landscape architects were from Boston—but the velvet grass and lush rose gardens are the work of the English climate and English gardeners.

The cemetery is laid out in a great quarter-circle, almost like the shape described by the hands of a clock reading three o'clock. Along the hour hand runs the Wall of the Missing, the names cut in Portland sandstone. Along the minute hand runs an avenue of trees. The rows of graves sweep in arcs between them. The white marble crosses and stars of David are washed every month. When the inscriptions become weathered, the stones are replaced.

The combat air crew buried here are those who came home mortally wounded, crashed on English soil, or whose bodies were recovered from the sea. Here also lie Eighth Air Force ordnance handlers killed in bomb-loading accidents. Here too are the Eighth's postal clerks, compa-



ny bakers, and Women's Army Corps members, dead of infections, car crashes, V-bombs, and natural causes. The headstones make no distinctions.

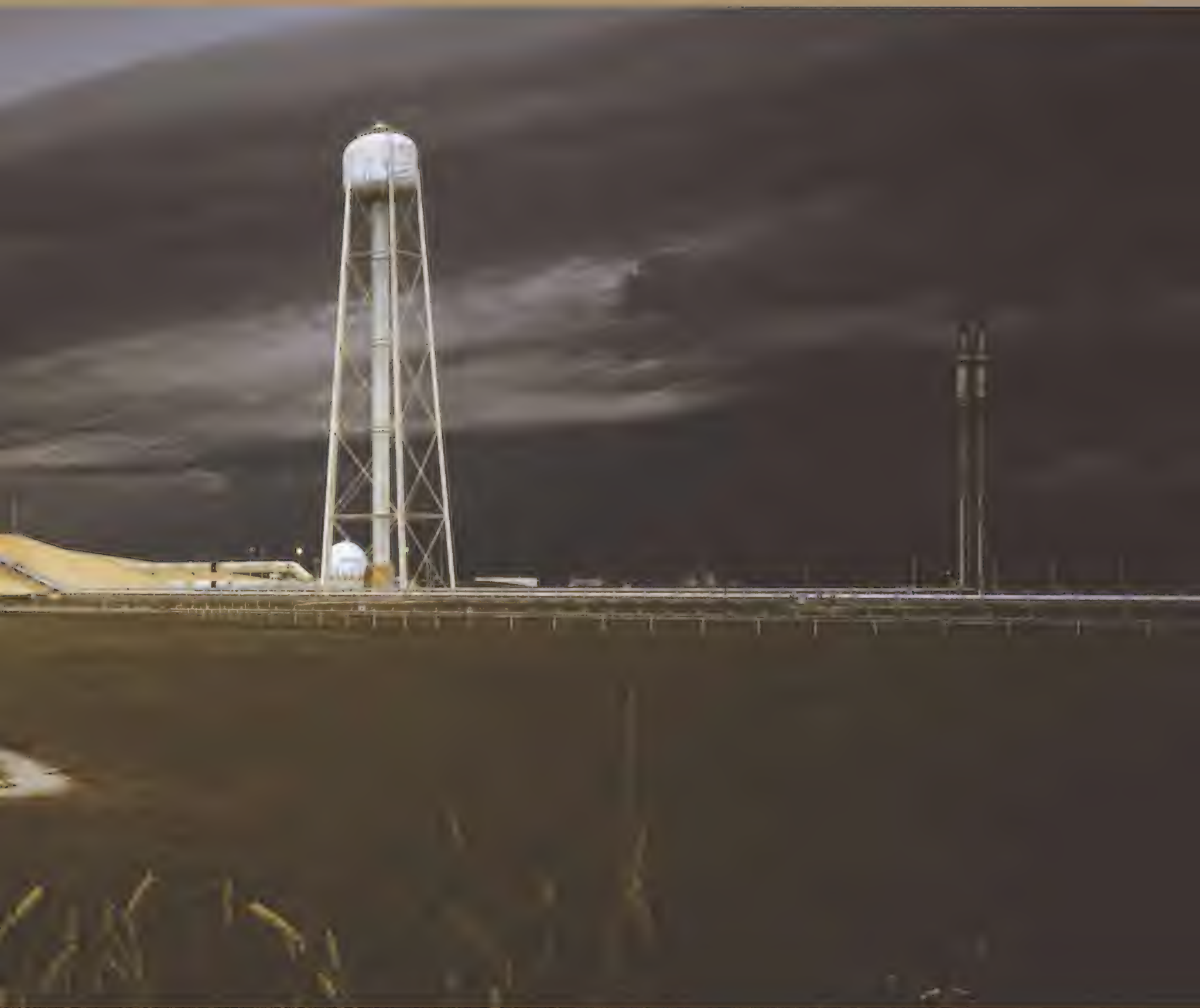
I had brought, from the museum at Thorpe Abbots, the name of Sergeant George J. Brassell, 418th Bomb Squadron, 10th Bomb Group, who is buried in Section F, Row 3, Grave 108. His airplane, a flak-damaged B-17 named *Dorhelcia*, went down in the North Sea on December 22, 1943. Brassell's body was the only one to wash ashore. The other nine crew members are remembered on the Wall of the Missing.

Brookes told me that when family members visit or request a photo of the stone, the staff presses wet sand gathered from Omaha Beach in Normandy into the inscription to make visible the name, rank, unit, date of death, and home state. The harmless sand is left in place. The rain carries it softly away. —

Sightings

PICTURES WORTH A SECOND LOOK





SCOTT ANDREWS KNOWS THE GROUND around Cape Canaveral, Florida, like he knows his own name. As the acknowledged photo guru of space shuttle launches—he has attended and photographed all but two—he also knows an opportunity when he sees one.

A former Associated Press photographer and current employee of Nikon, Andrews donates his time to NASA to serve as a troubleshooter for visiting photographers and to plant about 20 remote cameras around the site. He devised a way to trigger these cameras by the vibrations of a launch, enabling cameras to be placed as close as 800 feet from the pad.

On a late afternoon in September 2006, Andrews got a photo unlike any he had shot before. He was checking the remotes for damage from prolonged exposure to the elements, courtesy of repeated launch delays. Seeing a storm front approaching, Andrews lay in the grass to shoot *Atlantis* from behind the xenon lights that illuminate the pad for the benefit of night workers. The result is an image of a luminous shuttle, standing in stark contrast to the darkening sky.

Reviews & Previews

BOOKS, MOVIES, CDS, STUFF TO BUY

Fortunate Sons

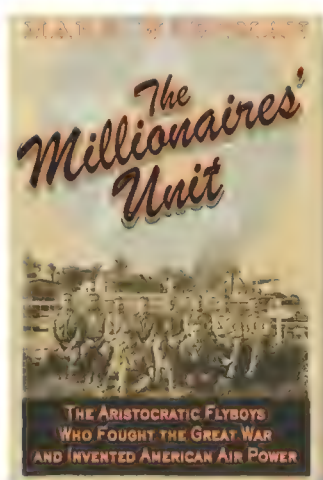
These young men had everything – except a license to fly.

TODAY, THE THOUGHT of a fighting unit made up of Ivy League volunteers from our country's leading families transcends fantasy, but it represented reality in 1916—a time when, author Marc Wortman writes, "Being a member of America's elite was not for the faint of heart."

With his readable account of the Yale Aero Club and its impact on U.S. Navy aviation, Wortman convincingly portrays a spirit of *noblesse oblige* that once permeated America's ruling class. He is somewhat less persuasive in arguing that the lads "invented American air power." They had, after all, considerable help from the U.S. Signal Corps and visionaries such as General Billy Mitchell.

Concentrating on six Yalies who set out to fly seaplanes, Wortman describes their training and their frustrated but ultimately successful efforts to join operational squadrons. He delivers uncommonly good descriptions of aerial combat. Memorable among these are the quotations from letters home written by Kenny MacLeish, younger brother of the poet Archibald MacLeish.

One of Wortman's Yalies,



The Millionaires' Unit: The Aristocratic Flyboys Who Fought the Great War and Invented American Air Power

by Marc Wortman. Public Affairs, 2006. 313 pp., \$26.

Trubee Davison, was the unit's organizer. Davison suffered debilitating

injuries in training and was unable to serve in combat (though he retained his U.S. Navy commission), but remained central to the group and later wrote a unit history, *The First Yale Unit*.

Of the other five, who were able to fly combat missions, two died in action, one became a POW, and three won the Navy Cross. David Ingalls became U.S. naval aviation's only ace of the Great War—at 19. In another war, Bob Lovett masterminded the Berlin airlift.

The author draws from previously unused original sources, including correspondence and papers left by members of the unit. The result is a well-researched history, in

which Wortman brings alive the idealism, bravery, and accomplishments of young American collegians from a different time.

Wortman closes his epilogue with a mention of a memorial on Yale's New Haven campus: It lists the 1,020 alumni who have fallen in every war since the American Revolution.

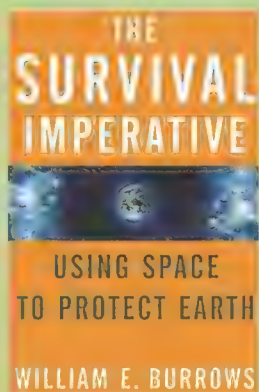
"No names have been added since the Vietnam War," writes Wortman. "Not for lack of wars."

WILLIAM JEANES IS A FORMER EDITOR-IN-CHIEF AND PUBLISHER OF *CAR AND DRIVER*.

In 1917, the Yalies honed their pilot skills flying Curtiss seaplanes out of West Palm Beach, Florida.



>>> From Our Contributors <<<



***The Survival Imperative:
Using Space to Protect
Earth***

by William E. Burrows. Forge, 2006. 317 pp., \$24.95.

AIR & SPACE/SMITHSONIAN contributing editor William E. Burrows offers a new mission for the U.S. space program: protect Earth from environmental disasters, military aggression, and extraterrestrial threats such as asteroids.



***Man and Machine: The Best
of Stephan Wilkinson***

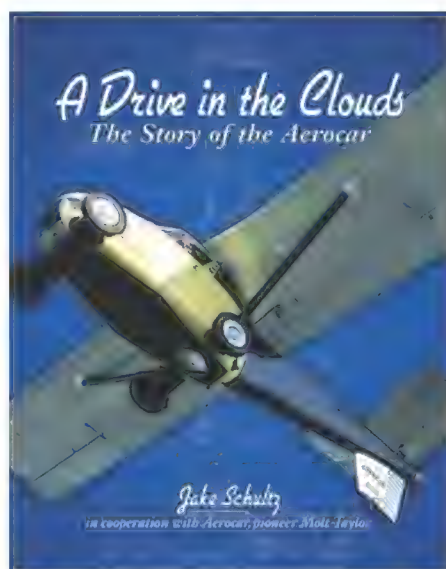
by Stephan Wilkinson. Lyons Press, 2005. 196 pp., \$16.95.

MAN AND MACHINE is a compilation of *Air & Space* contributing editor Stephan Wilkinson's magazine articles, in which he writes engagingly on subjects ranging from the Boeing B-17 Flying Fortress to aircraft ejection seats and painstakingly rebuilt V-12 piston engines.

***The High
Battleground: Air to
Air With World War II's
Greatest Combat Aircraft***

Photography by John M. Dibbs, text by James P. Busha. Boston Mills Press, 2006. 128 pp., \$39.95.

JOHN M. DIBBS, PHOTOGRAPHER for the popular "Flying Legends" calendar series, captures the majesty of restored warplanes in flight. In addition to Dibbs' color shots of 56 vintage prop planes, the book offers black-and-white archival images and recollections from World War II pilots.



***A Drive in
the Clouds: The
Story of the Aerocar***

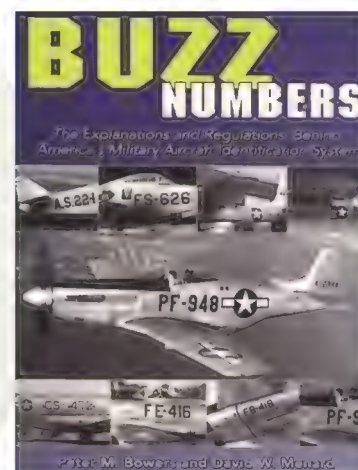
by Jake Schultz. Flying Books International, 2006. 128 pp., \$21.95.

THE PERFECT BOOK for people who love both cars and airplanes, *A Drive in the Clouds* has dozens of charming photographs, including several of aerocar visionary Molt Taylor.

***Buzz
Numbers***

by Peter M. Bowers and David W. Menard. Specialty Press, 2006. 96 pp., \$16.95.

BUZZ NUMBERS explains the rules and regulations behind the U.S. military's aircraft identification system.





The Man Who Ran the Moon: James E. Webb, NASA, and the Secret History of Apollo

by Piers Bizony. Thunder Mouth Press, 2006. 242 pp., \$24.95.

JAMES E. WEBB, NASA administrator from 1961 to 1968, has long fascinated students of 20th century American history. A Democrat schooled in the politics of the New Deal, Webb was an original. He was a political operator extraordinaire with an outsized persona, and he advocated for the space program with passion. One of his colleagues noted that talking with him was like “drinking from a fire hose.”

But it was Webb’s substance rather than his style that set him apart. He fused two powerful beliefs of the mid-20th century: that government should transform the social and economic landscape of the country, and that science and technology were potent means to such an end. When, in 1961, President John F. Kennedy set the United States on a journey to the moon, Webb, the

second administrator of the fledgling NASA, crafted a broad mandate for his agency: to accomplish the moon goal, foremost, but to use the gigantic undertaking—its national priority, its clout, and its dollars—to deliver more of the benefits of science and technology to nearly every state in the union.

In this biography, Piers Bizony, author of several books on space, seeks to invigorate appreciation of Webb’s accomplishments. The book has two aims. One is to argue that Webb’s managerial and political gifts made the new space agency a fixture in national life. The other is to look for the essence of Webb’s successes in behind-the-scenes decision-making and dealing with business and political elites (thus the use of “secret” in the book’s title); this aspect of the book is its strength. Bizony draws

on a number of oral history interviews (including ones I conducted at the National Air and Space Museum) to give a close, earthy portrait of Webb as he built up the agency for the moon journeys and, in 1967, endured the tragedy of and fallout from the Apollo 1 launch pad fire. Most of the material is not new, but the book, overall, stands as the most intimate portrait of NASA’s most colorful leader.

Unfortunately, the author never ties this engaging treatment to the book’s larger thesis, on Webb’s importance in NASA’s development and the agency’s place in American politics. Walter McDougall’s Pulitzer Prize-winning *...the Heavens and the Earth: A Political History of the Space Age* accomplishes the task much better and complements Bizony’s useful, popular biography.

MARTIN COLLINS IS A CURATOR AT THE NATIONAL AIR AND SPACE MUSEUM’S DEPARTMENT OF SPACE HISTORY.



>>> Cool Stuff <<<

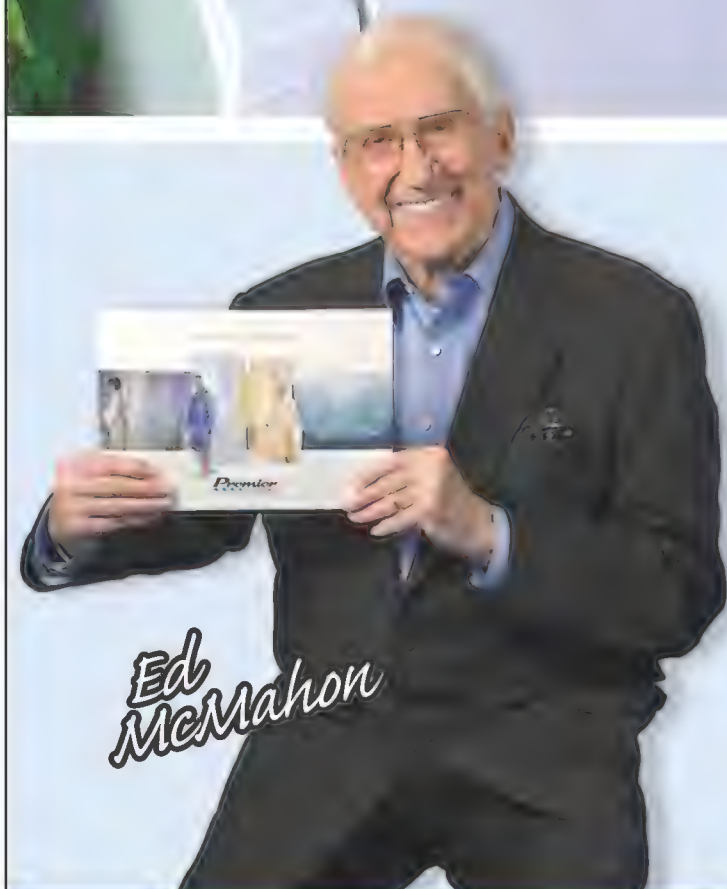
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Then & Now

FROZEN MOMENTS AS TIME MARCHES ON

Helping Hands

FUNCTION AND FIT are the main reasons why the glove of today's spacewalking astronaut looks so different from that worn by an Apollo moonwalker.

The Apollo-era A7LB had a short life-time—just one mission per pair—and was custom-made from a plaster-cast mold of each astronaut's hand with the fingers bent inward so that he could comfortably grip an object when the glove was pressurized. Designed to operate at a

pressurized 3.75 pounds per square inch, the glove consisted of an inner bladder of neoprene/latex and tricot fabric and an outer layer made of a woven

chromium steel fabric called Chromel-R.

"The old Apollo gloves were state-of-the-art at the time, but Chromel-R was about \$2,000 a square yard in 1968, so it was a very expensive way to go," says Bill Ayrey, manager of quality systems and company historian at spacesuit-maker ILC Dover in Frederica, Delaware. Though Chromel-R was sturdy, it had a tendency to split if over-flexed, as happened during many training missions on Earth.

"It would rip across the folds, like when you bend a piece of metal too much," says Ayrey, so each pair was only certified for a single mission.

The glove also could be painful to wear; many of the Apollo debriefing notes have comments from the astronauts about hand fatigue and pain from contact pressures around their fingernails.

By contrast, the glove worn by today's astronauts working outside the space shuttle or the International Space Station is "light years ahead," says Ayrey. The Phase VI has a useful life of 198 hours (an average spacewalk being six to seven hours) and the plaster-cast mold is laser-scanned to craft a more precise hand fit. Designed for a pressurization of 4.3 psi, the glove contains a urethane bladder and about 160 sewn pieces of lightweight polyester fabric and other materials. Both the choice of materials, and the way the pieces are stitched together, make the glove more flexible and more comfortable. A layer of silicone is troweled onto the Vectran palm fabric to create a good gripping surface, and the fingertips contain individual heaters. As for cost, the most expensive fabric on the Phase VI runs about \$100 a yard.

More glove changes are likely as NASA prepares to again send astronauts to the moon after 2015. Engineers responsible for designing a new spacesuit will "focus on reducing the overall suit weight, which would probably include the gloves," says Ayrey.

PAUL HOVERSTEN



The shuttle-era Phase VI glove (left) weighs 2.75 pounds, compared with the 1.45-pound A7LB glove of the Apollo program (right).

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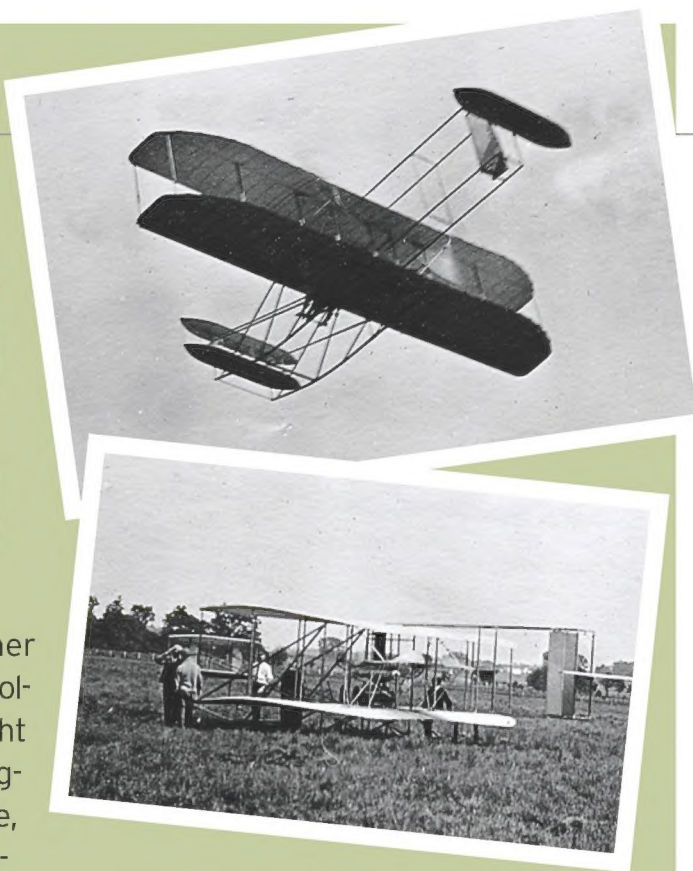
IN THE WINGS & ON THE WEB

Air & Space Readers, SHOW US YOUR PHOTOS!

We can think of few other groups with as broad a collective memory of flight as the readers of *Air & Space* magazine. To showcase this resource, we're inaugurating an online scrapbook featuring digital images from our readers' personal collections.

We're betting that many of you have historic treasure in your attics. For example, Ligeia Heagy of Berkeley, California, recently submitted two digital images of photos from her great-grandfather's scrapbook (above). National Air and Space Museum curators identified the aircraft in the photos as the Wright brothers' unique Model A/B. They were able to tell Ms. Heagy's family that the photos were made in Ohio during the spring of 1910.

If you have an aviation- or space-related photo that just reeks of historical importance, or merely personal meaning, please scan and submit it. Go to www.airspacemag.com and look for the "Reader Scrapbook" icon to find out how to submit your images.



The Wright Model A/B during 1910 trials.

IN THE NEXT ISSUE...

Airshows-a-Go-Go

Our annual nationwide guide to shows this year features Canada's exquisite, nine-airplane military demonstration team, the Snowbirds.

>>> Calendar <<<

February 24

"Remembrance of War" Seminar:

Hellcat Aces in a Day. Former U.S. Navy aviators Bill Hardy and Bill Watts recount their adventures flying off the USS *Bunker Hill* aircraft carrier during the Okinawa campaign.

Commemorative Air Force, American Airpower Heritage Museum, Midland, TX, (432) 563-1000, ext. 2260, www.commemorativeairforce.org.

March 31

"Remembrance of War" Seminar: Air

Force Ace Over Vietnam. Brigadier General Steve Ritchie, the only U.S. Air Force ace from the Vietnam conflict, speaks of his wartime experiences. Commemorative Air Force, American Airpower Heritage Museum, Midland, TX, (432) 563-1000, ext. 2260, www.commemorativeairforce.org.

March 16-18

Valiant Air Command's Tico Warbird

Airshow. Modern military aircraft flight demonstrations and vintage airplanes on static display. Warbird Museum, Titusville, FL, (321) 268-1941, www.vacinformation.org.

Organizations wishing to have events published in Calendar should fax press releases to (202) 633-6085; e-mail them to editors@si.edu; or mail them to Calendar, *Air & Space/Smithsonian*, MRC 513, PO Box 37012, Washington, DC 20013-7012.

>>> Credits <<<

Mrs. Whitley and the Victor.

Peter Lissaman went on to design wings for many aircraft.

What I Learned From Wrong

Way Corrigan. Dirk Woestenburger now flies as a passenger on airliners, where he trusts that Corrigan's lesson was not adopted by the pilots.

That Old-Time Profession.

Skydiver Tom Harpole says he'd rather jump out of an airplane than fly with a cropduster again.

Great Hero Yang.

James R. Hansen's most recent book is *First Man: The Life of Neil A. Armstrong* (Simon & Schuster, 2005).

Model Behavior.

Peter Garrison wrote about jet engine flameouts for the Aug./Sept. 2006 issue.

Restoration: "That Big Biplane."

Classic airplane owner Don Parsons happily documents the life and times of Creve Coeur Airport in St. Louis, Missouri.

And Then There Was One.

Stephen Joiner writes about aviation from his home in southern California.

How Things Work: Space

Station Truss. Adam Pitluk is a freelance journalist.

Life of a Salesman.

During a brief light-aircraft sales career, foul weather forced many unintended destinations upon Mark Huber, including a Denny's in Massena, New York, on Thanksgiving day 1995.

Shape Shifters. Michael Milstein is a frequent contributor.

We Recycle. Lee Ann Tegtmeier is a writer in Bethesda, Maryland.

In the Footsteps of the Mighty

Eighth. John Fleischman wrote *Black and White Airmen: Their True History* (Houghton-Mifflin, 2007).

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Why Fly?

THE WRIGHT BROTHERS may not have cared as much about speed as they did the sheer challenge of building a machine that would fly. Glenn Curtiss, on the other hand, figured it out right away: The airplane is all about speed. An ordinary railroad locomotive could outdo the first airplanes, and early exhibitions pitted aircraft against racehorses and another relatively new technology, the automobile. Today, such events are echoed every summer during the airshow season, when airplanes “race” against jet-powered cars. (It’s rumored that if the pilots don’t let the drivers win, their stubbornness costs them a case of beer.) At the beginning, though, the fact that an airplane flew was enough to draw crowds. And if it just flew around in a circle, well, that’s where the crowd was.

It took a while for airplanes to get big enough for pilots to think about setting distance marks, but even a frail little monoplane was able to leap the English Channel—a symbolic ocean—with a mustachioed Frenchman named Louis Blériot aboard in 1909. And Blériot had to do the math: fuel tank capacity and the rate of fuel consumption yield time in the air; multiply that by velocity and you get distance. Then Charles Lindbergh



The patron saint of record holders.

crossed a for-real ocean in another monoplane, one that was more like a winged gas tank. After that, there were no real limits. Speed and distance have always been the two performance records that counted the most, and today the National Aeronautic Association still marks more achievements in those two realms than in any other.

Someone once observed that the reason it took until 1986 for Dick Rutan and Jeana Yeager to fly around the world nonstop in *Voyager* was because nobody would ever buy a ticket on a flight that landed where it took off. But plenty would pay to fly from Nantucket, let’s say, to Morristown, New Jersey. Nobody in his right mind would start an airline to

fly such a route, though, so you need a pilot or a license and you need to own or rent an airplane. And the NAA’s files are literally stuffed with record flights between two towns that are well off the beaten airways.

Take Ed Figuli, for example. On July 13, 2002, he blistered his way between Allentown, Pennsylvania, and Fort Smith, Arkansas, in his Cessna 150, covering 947 nautical miles in 13 hours and 17 minutes, for an average ground speed of about 82 mph. Ed’s flight is likely to be the only record flight linking Allentown and Fort Smith for quite some time. Yet it is just one of hundreds that have laced city pairs all over the nation. A map with all these flights represented on it would have a web so dense that it would obliterate the continent.

People who don’t much care about flying probably wonder at the Ed Figulis of the world. But to people who think about the airplane, what it means to us, and what its purpose is, setting an NAA record is like making your own piece of history and a statement about why you fly. Luckily, the NAA makes it easy for people to set records. You can join online (www.naa.aero), check out the Contest and Records Department, and even order a kit with all the documents and instructions you’ll need. Or, if you’re into speed, just download one.

■ ■ ■ GEORGE C. LARSON, MEMBER, NAA

>>> Logbook <<<

The Wright Brothers Memorial Trophy

IN 1948, NAA ESTABLISHED the Wright Brothers Memorial Trophy, which is awarded annually to a living American for “significant public service of enduring value to aviation in the United States.” Former Transportation Secretary Norman Mineta was the 2006 honoree, in large part due to his calm and decisive approach to revamping airport security after the attacks of September 11, 2001.

Mineta was also recognized for his 40-plus years of public service. He is, in fact, the longest-serving Secretary in the history of the U.S. Department of Transportation, and the first Asian-American Cabinet member. Mineta was presented with the trophy – a rare-metal depiction of the Wright *Flyer* – at the Wright Memorial Dinner on December 15, 2006, hosted by the Aero Club of Washington, D.C.

VISIT THE NAA WEB SITE AT WWW.NAA.AERO OR CALL (703) 527-0226.